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CORPORATION

REPORTS RECEIVED FROM
EXPERIMENT STATIONS

1931-1932

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STATIONS, 1931-1932.**

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CONTENTS

	PAGE
PREFACE	v
AUSTRALIA:	
QUEENSLAND:	
BILOELA STATION	1
AFRICA:	
UNION OF SOUTH AFRICA:	
BARBERTON STATION	6
MAGUT STATION	25
SWAZILAND	32
SOUTHERN RHODESIA:	
INTRODUCTORY NOTE	39
GATOOMA STATION	40
NORTHERN RHODESIA:	
MAZABUKA STATION	48
ANGLO-EGYPTIAN SUDAN	81
UGANDA	91
NYASALAND:	
INTRODUCTORY NOTE	100
DOMIRA BAY STATION	102
MAKWAPALA STATION	117
PORT HERALD STATION	128
NIGERIA:	
DAUDAWA SEED FARM	132
IRAQ:	
RUSTAM STATION	157
WEST INDIES:	
ST. VINCENT STATION	161
FIJI:	
SIGATOKA STATION	165

PREFACE

By J. C. WILLIS, M.A., Sc.D., F.R.S.

In accordance with the rotary scheme, which was described in last year's preface, four only of the Experiment Stations supply full Reports. These come this year from Northern Rhodesia, Nyasaland, Nigeria and Fiji. The remainder of the Stations send summaries of the principal results obtained.

In discussing the contents of the several Reports, it is intended to consider the various topics in the same order as last year, dealing first with the work on breeding, then with the improvement of agricultural efficiency, and lastly with pests and diseases, their prevention and cure.

For the last few years, one of the most interesting features in these reports has been the success of U.4 in South Africa and the colonies to the north of it, and we may begin as last year with this subject. By this time, of course, the work is mainly concerned with the various strains that have been, and are continually being, derived from U.4 by further selection, forms which in general have been successful. At Barberton itself, which one may call the headquarters of the race, the season interfered very much with the success of the trials that were carried on, but better results were obtained upon Mr. Arkell's farm near by. The yield of over 460 lbs. of lint per acre was very good indeed, and the strains are evidently well suited to the district. A great step, due wholly to the work of the Corporation, has been taken towards the establishment of an important industry in the low veld.

At Magut in Natal, improved strains produced at Barberton were tested under what proved to be very serious climatic disadvantages which finally culminated, as such difficulties are liable to do, in a severe insect attack, in this case bollworm, which so damaged the crop that the work had to be abandoned for the year.

At Gatooma in Southern Rhodesia the strain U.4/64 has proved to be of great value. Two of its derivatives are being issued for multiplication in the districts, and the strain itself will be the one chiefly cultivated during this season. In Northern Rhodesia also, derivatives of U.4, especially those which matured early, proved significantly better than the late maturing strains and than the U.4 bulk. Further selection experiments met with difficulties on account of the great differences within the different soils, and further work is needed before proceeding with them.

In Nyasaland, the plant breeding work has now been concentrated at Domira Bay. Work here also was mainly concerned with U.4 and its derivatives. It is proving to be "very satisfactory as a high-yielding

strain adapted to growth under various conditions." The yield at one place, 1,812 lbs. of seed-cotton per acre, was the highest yet recorded in Nyasaland. A good deal of work was done with derivative forms, some of which were crossed with types from the Trinidad Research Station, and from Brazil. The report also describes the change over in the country from Nyasaland Upland seed to U.4, though the supply of the latter did not quite hold out and had to be supplemented.

The complaint in Nyasaland against U.4, which is very satisfactory in so many ways, is that its lint is rather harsh, and the same complaint is made in Uganda, where also U.4 did fairly well, though so far from its original home. In Nigeria it failed to stand out as a marked success, but in that country it is in a very different climate indeed. It is clear, however, that for South Africa and for climates not too dissimilar from that, the strain is a very great asset; and improvements are steadily being made.

While, in the Union of South Africa and Rhodesia, practically all the breeding work is concerned with strains of U.4, attempts are being made in Nyasaland to improve the quality of the lint by crossing with other forms. If the lint could be softened without losing other valuable qualities, U.4 would have even a greater range of possible utility than it has at present. It is too early yet, however, to expect any results from the crosses that are being made.

In Uganda breeding work has been largely restricted to strains bred mainly at Bukalasa and at Serere, some of which showed significantly less infection at the start by angular leaf-spot, while some had higher yields of lint. U.4 occupied a low place in this respect, at this distance from its original home, and also proved less satisfactory in the spinning tests. Some good selections have been made from Cambodia at Serere, which are very resistant to jassid, and recover well from Blackarm.

In the Sudan, resistance, whether to Blackarm or to Leaf curl, forms perhaps the most urgently desirable character in all strains at present, and several forms among the Egyptian $\times$ Sea Island types showed this to a high degree, the infection being much less than on the control plots of Egyptian Sakel. Various strains of Shambur, Delrect, etc., are being propagated upon a larger scale. Of the American types, some recent selections, notably, X.A. 1129, gave much increased yields, as compared with the controls, and good results on spinning; this strain is to be used for more extended trials.

Much of the work done at the Experiment Stations comes under the head of improvements in the efficiency of agriculture, and we may consider first the rotation of crops, a subject of great importance, to which an increasing amount of work is being devoted. A good deal

of space in the reports is given to work upon rotation crops, but as yet few districts have worked out a very definite plan of a rotation that will give the most satisfactory results, for as we have explained in previous prefaces, there are so many factors that affect the final result, especially the profitableness of the possible rotation crops under the various local conditions that exist in the different places. Maize, millets, guinea-corn, ground-nuts, and quite a number of pulse crops, all seem promising for inclusion in rotations in various places, but each place will evidently have to work out its own rotation, and it is unlikely that the work will lend itself to much in the way of generalisation.

Mixed cultivation, or intercropping, which give some of the advantages of rotation in a different way, are under trial in one or two places. Fallowing is dealt with in South Africa and in Queensland, and here again it is evident that each place must decide for itself what is best and most economic. Subsoiling was tried in Natal, but the results were unconvincing.

Experiments in different spacings of plants have been continued at a number of stations. But the best spacing will have to be determined for each individual place in view of the different local conditions. Hardly any two are likely to agree exactly.

Experiments with time-of-planting of cotton showed that in Northern Rhodesia early planting was definitely superior as regards yield of crop, and the same was the case in Nyasaland. In general, wherever it has been tried, early planting seems to give better results, but again the best time will have to be determined for each individual district, for it will vary with local conditions, whether of climate or soil, or incidence of insect attack.

Time of ploughing was experimented with at Barberton, and autumn ploughing appeared to be better than winter or spring. Cultivation has been a subject of interest in Nigeria, where there are indications that too much cultivation (or perhaps too much at certain times) may lead to excessive erosion, even though the actual amount of cultivation done may be small when judged by European practice.

Various other items in the cultivation and preparation of cotton have also been the subjects of investigation, *e.g.*, the de-linting of seed in Queensland, interchange of seed in Uganda, topping in Nigeria and Fiji, cattle in Nigeria, and so on.

In Nigeria a change of policy is adumbrated at the Seed Farm, the Agricultural Department thinking that multiplication of seed need no longer be its first objective. Nothing has yet been found that is sufficiently superior to the ordinary commercial variety to be worthy of special large-scale multiplication, while at the same time it is

desirable to spread the gospel of mixed farming among the cultivators (cf. Faulkner's article in E.C.G.R., Jan., 1933).

The climates that have been experienced among the various experimental stations show the usual variety, and the remarks made upon the subject in last year's preface may be repeated, only the names being changed. The two Rhodesias, Nyasaland, Sudan and Nigeria, or a little more than the usual number, had what may be termed a fairly good cotton season, the rest an indifferent or bad one.

Turning finally to the incidence of the numerous pests and diseases to which cotton is subject, and to the work that has been done towards dealing with them, it may be noted that the opinion, that in general they are symptoms of something not being quite right with the weather (at or before the time of the outbreak), with the soil, with the strain that is in cultivation, with the methods employed in the cultivation, or with some other feature of the whole process of growing cotton in that locality from seed to fruit, is steadily gaining ground. If this prove to be a sound deduction, it is clear that the treatment of pests or diseases will in future come to be of a more fundamental kind, by the amelioration of whatever is lacking in, or wrong with, the conditions, as well as by direct treatment of the outbreak when it occurs. But it will be altered more in the direction of prevention than of cure.

The most important pest is the one generally classed under the term bollworm, though there are several different insects whose larvae appear under this head, *e.g.*, the American bollworm (*Chloridea obsoleta*), Sudan bollworm (*Diparopsis castanea*), Spiny bollworm (*Earias spp.*), etc. Nearly all the stations report more or less bollworm, but few, except Queensland, had severe attacks; in Queensland it was an outstanding feature of the season, and it is noticeable that another feature was a long and severe drought.

In Northern Rhodesia it is stated that stainers and American bollworms are limiting factors in the establishment of cotton as a commercial crop in N.W. Rhodesia. A good deal of study was given to the bollworm in both Rhodesias and in South Africa, and a number of new facts were observed, though as yet there seems little approach to any method of control. Later plantings were found to suffer less, but this was more than counter-balanced by the small yield which they gave as compared with the early plantings, and by the fact that they suffered more from stainer. Figs. 9 and 10 under Northern Rhodesia show some of the interesting results of this study.

In South Africa, much work was done upon the *Trichogramma* parasite of the bollworm, and it was found that the handling of this tool will not be the simple matter that it might have seemed at first,

for there are different strains that react in different ways to the different host-material and to the temperature, so that a sorting out of parasites suited to summer and to winter releases will be needed. Another fact of considerable importance that was noted was that the American bollworm appears to lay its eggs mainly upon the larger plants. It also feeds upon a number of winter-grown crops in the district. Experimental releases of the parasite are being made upon these crops, and in the actual area of release a considerable amount of parasitism has been observed, so that good results may be hoped for if the method can be made efficient and cheap. Records of bollworm attack were made at many stations.

Stainer (*Dysdercus*) is perhaps the next most formidable pest, and in South Africa and especially in Northern Rhodesia it has been the subject of a good deal of investigation. It has caused considerable damage to cotton, either directly or as a carrier of internal bollrot, in most of the stations and districts. Wild host plants have been found among other Malvaceae and the allied family Sterculiaceae, able to carry over a population of stainers until the next cotton season (seasonal distribution, etc., are shown in figs. 1-5 under N. Rhodesia). In Northern Rhodesia it has been found that humidity is of importance, one species of stainer appearing when it is drier, another when it is more damp. It was also found that the soil conditions there, through their action upon the plant, exert a marked influence upon the degree of staining. Staining was found to be consistently heavier upon the darker soil (*cf.* fig. 8), so that though this soil gave the heavier crop the ultimate result was much the same as upon the lighter coloured soil. Results previously obtained supposed to show the value of trapping and of handpicking (in 1930) are now regarded as vitiated by what has been ascertained as to the influence of the soils.

In Fiji a year's close season is to be observed, and observations will be made upon the effect of this upon the incidence of stainer and other pests. False stainer (*Aulacosternum nigrorubrum*) was common in Queensland.

Other insects are mentioned as injurious in various of the reports. *e.g.*, White fly and Thrips in Iraq, jassid in various places (in some of which U.4 was found susceptible to it), Aphis in Southern Rhodesia and Queensland, *Heliopectis* and *Lygus* in Uganda, Harlequin bug in Fiji and Queensland, Tipworm in Fiji, Beetle in Natal.

Locusts were troublesome in Nigeria.

Of diseases, as distinguished from pests, Blackarm is considered under Uganda and Fiji, *Rhizopus* in Iraq, Leaf curl in Sudan, and Bollrot in connection with stainers (above).

QUEENSLAND

REPORT ON THE WORK OF THE COTTON RESEARCH STATION, BILOELA, FOR THE YEAR ENDING JUNE 30, 1932.

SUMMARY OF RESULTS.

BY

W. G. WELLS.

The climatic conditions of the season under review were characterised by exceptionally long periods of high temperatures and a total rainfall of 14·07 inches, the lowest in the sixty seasons of recorded observations obtainable for the district. Only light showers, which just enabled good seed beds to be prepared, occurred prior to mid-December, when a series of storms totalling nearly 3 inches allowed of general planting. A period of exceptionally high temperatures, accompanied by dry conditions, which was broken by only a light shower in December and one storm of 1·15 inches in mid-January, prevailed from then onwards until April. Scattered showers in April and two light rain groups in May helped to fill what bolls developed, although the seed and fibres were of exceptionally light weight. Fortunately killing frosts were not experienced until July, which enabled most of the crop to mature.

As would be expected under such disastrous conditions, methods assisting the conservation of moisture were decidedly beneficial. But for a most unusual attack from the rough bollworm (*Earias hugeli*), surprisingly good yields would have been obtained in many plots on the Station which incorporated this feature. These yields would have been greatly increased had one light storm been received in mid-February to break the period of intense temperatures and high evaporation.

Naturally under such conditions most of the experiments yielded data of little value. Some interesting results were obtained, however, and are briefly summarized as follows :—

1. Under the conditions of low summer rainfall, marked advantage was obtained through growing cotton in rotation with a long season fallow.

2. On a soil with a high nitrogen content and a low C/N ratio, rotating with a long summer fallow may be dangerous, however, especially with late-planted drought-resistant types of cotton with a tendency to make vigorous growth. The risk is that the occurrence of a heavy mid-seasonal storm would cause excessive plant development favourable to insect attacks and square shedding.
3. Cotton following a panicum crop cut for hay late in the previous summer made taller growth, was more drought-resistant, and outyielded cotton following cotton. Although an eight month fallow, during which only light rains were experienced, occurred between the harvesting of the panicum and planting of cotton, the yield was appreciably less than where cotton followed a whole season fallow. Cotton following maize likewise yielded less.
4. It would appear, therefore, that while some advantage was gained through growing cotton in rotation with crops not having deep tap root systems such as has the cotton plant, greater advantage was obtained by growing cotton following a long season fallow. This may indicate that there was more moisture in the upper layers of the long-fallowed soil, which allowed the cotton plant to develop a better upper lateral rooting system. Such a system would enable the plant to obtain more assistance from light storms, such as occurred in April, than would be possible for a plant with a smaller lateral system, although with a tap root of equal dimensions. With such light rainfall as was experienced, it is probable that a greater supply of nitrates was also available in the upper layers in the long-fallowed soil.
5. Planting undelinted seed in the dry soil enabled a strike to be obtained with a light shower, which was insufficient to allow of planting in the ordinary manner after the rain had fallen. Only a fair commercial stand was secured, however. As a fortnight intervened before a "planting" rain was experienced, a gain of three weeks in time of flowering was obtained with the dry planting.
6. Planting soaked, undelinted seed after a planting rain had fallen, gave an appreciable advantage in the germination showing above ground on the fourth day after sowing, as compared both with delinted and with ordinary undelinted seed, which ranked in the order given. On the eighth day after planting the soaked, undelinted and the delinted seed

were of equal value and had 25 per cent. better stand than had the ordinary undelinted.

7. No significant differences in yield were obtained between the dry planting and the three above-mentioned methods of planting, although the dry planted seed actually yielded consistently lower than the rest, which were practically of equal value. It is believed that the smaller plant population, plus possibly a greater moisture stress during the period of intense temperatures, due to the earlier setting of the crop, caused the lower yield in the dry planting.

The unusual occurrence of *Earias hugeli* in sufficient numbers to cause severe economic loss was the outstanding entomological feature of the season. This was also the case in most of the commercial crops in the adjacent district and in other cotton-growing sections of the State. The False Stainer (*Aulacosternum nigrorubrum*) was very numerous throughout the season, particularly in its early part. A severe attack of Aphids was experienced late in the season when the crop was opening, and considerable lowering of the grade resulted. *Dysdercus sidae* appeared when the first bolls opened, and increased in numbers for a while, but eventually declined to a marked extent, never being a serious factor. Pink bollworm (*Platyedra gossypiella*) was found to some extent, limited examinations indicating that 1½ per cent. of the bolls had been attacked. The Harlequin Bug (*Tectacoris lineola*) occurred in increasing numbers during the latter part of the season, until the first frost was experienced, which was disastrous to them. This pest was more prolific than in any of the five previous seasons.

GENERAL REMARKS ON THE 1931-32 COTTON CROP IN QUEENSLAND.

Reduced prices for maize and other agricultural crops produced in the cotton-growing districts, and greater production by the Australian mills, greatly increased interest in cotton-growing during the winter prior to this season's planting. Growers expanded their acreages, and many farmers who either had not grown cotton before or who had not tried this crop for several seasons, also ordered seed, a total amount sufficient to plant approximately 61,000 acres being issued to about 5,000 growers, which was a record acreage for the State. Unfortunately the greater portion of this acreage was planted in the Central district under conditions similar for the most part to those existing at the Research Station. The Southern areas were more

favoured earlier, however, and up to mid-January gave promise of producing record yields. But from then onwards the period of extremely high temperatures without rain until April, was experienced in these areas also.

The results of such severe conditions, in conjunction with the widespread *Earias* attacks, were disastrous in all districts, many growers failing to harvest anything off even large acreages. A few Southern growers, who were fortunate enough to receive a storm early in February, obtained around 800 lbs. of seed cotton per acre, which illustrates the value of the mid-seasonal rains. As it was, a total of only 6,169,279 lbs. of seed cotton was produced for the season.

In spite of such disastrous results, the acreage for the 1932-33 crop will be increased, as seed sufficient to plant 70,000 acres has been issued. Good planting rains occurred in all districts during the latter half of October, which is a planting period well suited to give highly profitable yields. As the seasonal conditions are the best for many years in some districts, the outlook for a record crop is promising.

—RAINFALL AND TEMPERATURE GRAPH—

BILOELA.

1931-32.

—SEASON—

Three Day Means
 { Maximum
 Minimum
 Means of PREVIOUS 5 YEARS

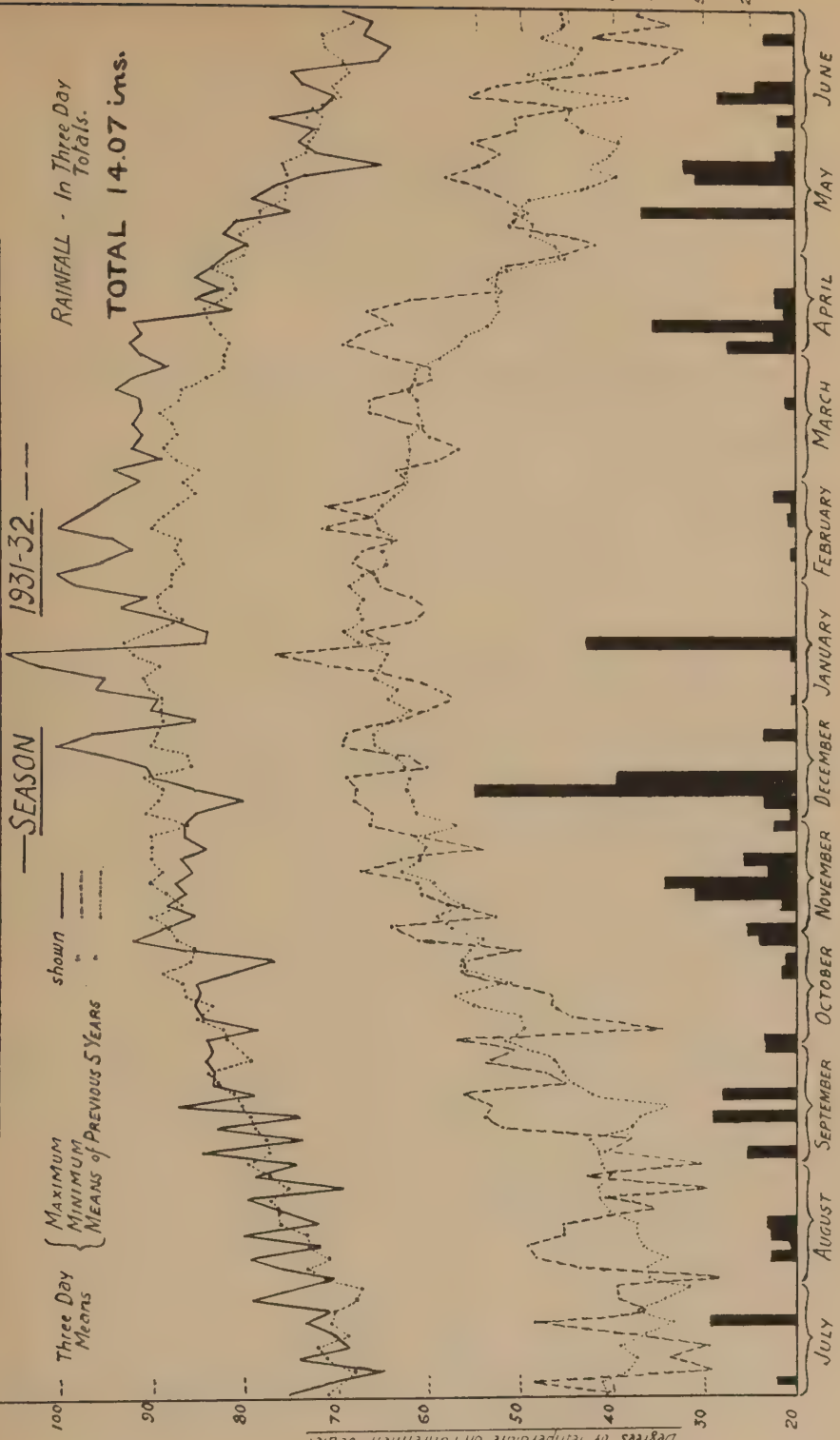
shown —

RAINFALL - In Three Day Totals.

TOTAL 14.07 ins.

Degrees of Temperature on Fahrenheit Scale.

Points of Rainfall.



SOUTH AFRICA

REPORT OF THE CORPORATION'S WORK AT THE STATIONS AT BARBERTON, TRANSVAAL, AT MAGUT, NATAL, AND IN SWAZILAND, FOR THE SEASON 1931-32.

THE COTTON-BREEDING STATION, BARBERTON. SEASON 1931-32.

SUMMARY OF RESULTS.

COTTON-BREEDING AND FIELD EXPERIMENTS.

BY

F. R. PARNELL.

GENERAL.

Season.—The season was a poor one for cotton in the Barberton area since the rains were short, badly distributed and irregular, and yields were on the low side generally. The acreage under cotton was much reduced as the low prices ruling at planting time, aggravated by the prospect of heavy losses on exchange, gave little hope of a profitable crop. The result has been a very small crop from this area.

On the Station fair rains were received early in November and the variety trials, selections and bulks were planted in good conditions by November 13th. Further planting was held up by lack of moisture till after the middle of December. The early plantings gave fair stands, but growth was poor owing to the very dry conditions that prevailed for about a month after germination.

On December 5th a violent dust-storm swept over the Station and destroyed a good deal of the young crop. Plants that were left, apart from specially sheltered patches, took some time to recover and were very slow in starting healthy growth, even after rain. As will be seen from the Rainfall Table and Chart, the growing crop experienced two long periods of essentially dry conditions, one from the middle of December to the second half of February, the other throughout the greater part of March and April. The result was that, where stands were relatively good, *i.e.*, anything approaching a full stand at $3\frac{1}{2}' \times 2'$, the growth and yield were poor; in cases where the dust-storm had thinned out the stand considerably, the remaining plants made use of the extra root-room and moisture available and gave a much better growth and good yields per plant.

Insect Pests.—There was very little bollworm and practically no jassid during the season. Stainers, however, did very considerable damage to the later cotton. The crop generally was not really late, except for a few re-planted areas, but the retardation caused by the dust-storm laid it open to more damage by stainer than would have been the case otherwise.

SELECTIONS.

The previous season, 1930-31, started so late that serious doubt was felt as to the fate of the single-plant selections if all the seed were planted. Very fortunately it was decided to plant only half the seed available and to retain the other half as a reserve. The crop of that season failed to open properly and gave little good seed, owing to its lateness and the consequent damage caused by stainer. The above reserve seed, therefore, *i.e.*, seed from the 1929-30 crop, was planted in the season under report.

The block of selections was cut about badly by the dust-storm and the final stands, in many cases, were not good enough for accurate comparisons to be made between lots. In spite of this, however, useful progress has been made. The large differences, both inside and between the chief strains, showed up well enough to allow of many lots being discarded. In cases where satisfactory comparison was impossible, bulk selections were made from single-plant lots for re-planting these in the next season. Where the stands were better, single-plant selections were made in the ordinary way. In no case was any strain so badly damaged as to be lost.

The newer selections contain some very promising material and it is confidently anticipated that some of them will form definite improvements on the older strains now being tested in bulk. It is very satisfactory that some of the most promising lots are derived from strains that were particularly resistant to jassid when this pest was worse than usual in the 1929-30 season.

Some idea of the general yields may be gathered from the fact that the bulks, taken from normal typical plants only, mostly averaged from 60 gms. to 80 gms. of *lint* per plant. In view of the poor season these results are surprisingly good.

VARIETY TRIALS.

Of the older strains, available in bulk, all that had previously shown some promise were included in variety trials on the Station. Four separate trials, each giving six repetitions of 13 strains, were planted

over an area of 10 acres. Of a total of 26 strains the best 18 were included in two trials, the remainder appearing only once.

This was the most disappointing part of the whole season's work. The dust-storm ruined one trial entirely and it was ploughed out. Two trials were so badly damaged that they could be used for observations only, no attempt being made to get yield figures, and the fourth was so affected that yields could be taken only from groups of plants and not from complete plots. The information obtained from these trials was of some use, but it did not represent much progress in the testing of the strains.

A very satisfactory variety trial, comprising 13 of the best strains, was very kindly planted by Mr. D. J. Arkell on his farm a few miles from the Station. This was planted early, the end of October, on a light granite soil, and received rather more useful rains than the Station. All the strains made a satisfactory, moderate growth, fruited well and gave a very good crop. The crop was very early, the last picking being finished on April 12th., exactly $5\frac{1}{2}$ months after planting.

The five leading strains gave yields ranging from 470–486 lbs. *lint* per acre, against 457 from U.4. Bulk. The four lowest yields, 411–424 lbs. per acre, were from strains that had given generally poorer results elsewhere. A difference of 53 lbs. *lint* per acre was required for significance ($P=0.05$), and the four best strains were all significantly better than the four worst, though none was significantly better than Bulk.

The yields may be considered excellent for the soil and season and it is obvious that the strains under experiment are very well suited to the area.

After the dust-storm had damaged the variety trials on the Station a late-planted trial was put in on 16th December, comprising a selected lot of 13 strains. This was too late for the results to be of general application, but it showed up some of the weaker strains, in addition, as would be expected, to favouring the earlier types.

MISCELLANEOUS.

Fertilizer Experiment.—A cotton fertilizer experiment was laid down, to be carried on for several seasons, in which Nitrate, Potash, Superphosphate at two rates of application, and Nil were compared. The cotton was planted late, 14th December, and did not come to much. Growth was fair, however, and was quite sufficient to show differences due to the action of any of the fertilizers.

Weekly measurements of growth of the main axis failed to reveal any effect. An analysis of samples of plants for dry-weight was made towards the end of the season, for Phosphate and Nil plots only, and

gave 127·7 gms. per plant for Phosphate plots against 117·6 gms. for Nil. The difference was definitely significant ($P=0.05$). The yields of seed-cotton were poor and no differences due to fertilizers could be seen from the figures.

Spacing Experiment.—A spacing experiment was planted on 23rd December. It was too late to be any good as it did not become well enough established to stand the long drought that followed. The stand suffered, growth was poor and it had to be abandoned.

PLANT PHYSIOLOGICAL WORK.

This work was started on the usual lines by Mr. Heath. Unfortunately he fell ill in February and was away for the remainder of the season. His work was continued as far as possible, mainly by Mr. J. D. Jameson of the Uganda Agricultural Service, but much of it had to be given up. The results will be given by Mr. Heath in next season's report, but one or two points of interest may be noted here.

Time of Ploughing Experiment.—Replicated plots were ploughed as follows :—

Autumn—29th April, fair moisture and moderately friable.

Winter—3rd September, very dry and rough.

Spring—9th October, after rain and friable.

Regular records on plant development throughout the season were taken from cotton planted on these three sets of plots. The Autumn plots gave a definitely better growth and general development, from beginning to end of the season, and finished with a better yield than the other two. Winter and Spring gave about the same growth of the main axis but the winter plots gave rather better general plant development and a higher final yield than the Spring.

Fallow Experiment.—Replicated plots of fallow, maize and soya beans were laid down for this experiment in the previous season and cotton was planted over the whole in this season. The dust-storm damaged the plots considerably and rendered impossible some of the work that had been intended.

Weekly measurements of the main axis showed that the fallow plots started rather lower and then went ahead in growth from about the last week in January and showed an increasing lead over the other two treatments till the end of March. The maize and bean plots were about equal throughout. On April 2nd the mean heights were :—fallow 95·4 cms., maize 78·2 cms., beans 75·2 cms.

It is presumed that the fallow plots held a better reserve of subsoil moisture and that this came into play owing to the very dry period throughout January and early February.

FIELD EXPERIMENTAL WORK ON ROTATION CROPS.

BY

W. L. FIELDING.

GENERAL.

Attention had again been concentrated on those crops which have been indicated in previous Reports as showing most promise. These are maize, soya bean, tepary bean and sunflowers. Apart from the carrying out of definite investigations into such problems as the varietal question, spacing etc., in connection with the above crops, the policy of growing observation plots of newly introduced types of various crops has been pursued. Work on groundnuts has also been continued, though the likelihood of "rosette" disease proving a limiting factor in this area prevents the inclusion of this crop in the range of most promising types.

Despite the adverse nature of the season some useful information has resulted from the work. Apart from experimental work on the culture of these crops, investigations into market possibilities in the interior have been vigorously pursued and a certain amount of progress made. The exceedingly low prices prevailing for all agricultural produce make it very difficult to gauge the value of the various crops and considerably hamper the work of introducing them to farmers in the area.

The various outstanding conclusions mentioned in the following paragraphs have been reached by careful observation, substantiated by data from trials laid out on accepted randomized block principles.

SOYA BEAN (*Glycine max*).

The Variety Question.—The Yellow 1 type has now been accepted as standard for present use, owing to its resistance to shattering. Yellow II, on further trial, has shown no advantage over Yellow I.

A range of soya beans procured from the United States of America the Philippine Islands and various parts of the Union all proved inferior to Yellow I in growth and shattering behaviour. The only type of interest was Laredo, which proved practically immune to Eel worm (*Heterodera*). The possibility of breeding from this strain would be of interest were soya beans grown as a rotation crop on tobacco lands.

Analysis.—Plots of various strains of soya beans have been grown at Barberton, over several seasons, in connection with an investigation by the Potchefstroom Experiment Station into the influence of soil and climate on the composition of the beans in different areas. The broad

conclusions reached are that climate has considerable influence on composition, as far as protein and oil contents are concerned. Barberton samples were in every case significantly higher in oil, but lower in protein than the Natal (Cedara) beans, for instance. Soil type appeared to have no effect.

Spacing.—The main experiment was an extensive spacing trial, giving two dimensional variations in spacing treatment. This again demonstrated that the Yellow I strain is not capable of utilising space economically beyond certain limits. Spacing of 12"×6", 32"×4" and 22"×6" all gave similar yields of just over 1,100 lbs. per acre and were very significantly better than 32"×8" and 22"×12", which spacings yielded just under 700 lbs. per acre. The maximum area available per plant without reduction in yield seemed to be in the region of 130 sq. ins.; the 12"×12" spacing treatment (area 144 sq. ins.) was just significantly worse than the first three treatments mentioned above, but was still definitely better than the two wider treatments allowing 256 and 264 sq. ins. per plant respectively.

It is possible that another season may show up different results, the past season having been very dry, the plants being definitely small compared with previous seasons.

Investigations into the influence of lime on nodulation and yield are being continued. The question of inoculating new soya bean lands by means of "soil cultures" is also receiving attention.

Markets.—A sale of 20 tons of Yellow I soya beans was recently arranged between certain growers and an oil expressing company at Germiston. Soya bean oil is used in a large miscellany of manufactures and the residual "soya cake" is readily saleable as a cattle food. The results of the experimental crushing will enable the oil crushers to gauge the commercial possibilities within the Union.

MAIZE.

Varieties.—It appears probable that in the Barberton area maize is not likely to be produced in large quantity for export or sale outside the district. Most farmers, however, will grow some maize, largely for purposes of feeding their native labour and cattle. What is therefore needed is a white-grained maize suitable for grinding into a meal acceptable to the native palate; the maize should be capable of maturing its crop in a shorter time than the long period strains habitually grown, and should have drought-resistant qualities. The nearest approach to these requirements is the White Flint maize which has done well under observation for three seasons and which more definitely proved itself in a properly designed variety trial this year.

A considerable quantity of roughly rogued bulk seed has been issued to farmers in the area for planting in 1932-33.

Under good conditions a strain of the Hickory type has shown itself capable of giving a higher yield than the White Flint and its grain is of higher market value. It is felt, however, that the planting of longer growth period, dent types of maize is a somewhat uncertain proceeding in this area.

The dark-red Peruvian strain has again shown promise. With its very short growth period, drought-resistant properties and high degree of resistance to "streak" disease it may prove to have a use for planting up lands which are not got into condition till very late in the season. There is only a limited interior market for grain of this type, but it is reported as being better suited to export markets than any other type of maize at present grown in the Union.

Fertilizers.—A small variety of maize was planted over the 1930-31 Cotton Fertilizer Experiment with a view to testing the residual fertilizer effect on the growth and final yield of the maize. The outstanding effect was that of phosphate which greatly improved growth and doubled the grain yield. Neither potash or nitrogen showed any residual value.

SUNFLOWERS.

Variety Trial.—The final grain yields showed no statistical difference between the black strains, B.2, B.4, B.6 and the large grey striped strain St.3. The white strain, W.1, was definitely poorer. One of the main drawbacks with sunflowers has been that their long maturation period makes it difficult to get the crop off early enough to do satisfactory Autumn or early Winter ploughing. The results of this trial are, therefore, useful, in that St.3 has shown itself capable of giving as good a yield as the B strains, but it takes three weeks to a month less to mature. B.4 has again shown up as a rather earlier strain than B.2 and B.6, which latter has up to now been the standard strain used on bulk fields.

Spacing.—The general inferences quoted on p. 23 of "Reports received from Experiment Stations, 1930-31," have been confirmed in the trial with the B.6 strain this year, and it would seem that with the black strains, and an inter-row distance of 3', an inter-plant distance of 30" is probably the optimum.

It has been decided to use the St.3 strain for future sunflower spacing and fertilizer trials. It will also be used in the permanent rotation experiments which will be laid down for the first time in the coming season. Grey striped sunflowers are reported the best for export purposes.

TEPARY BEAN (*Phaseolus acutifolius*).

This continues to show up as a very useful leguminous crop, points in its favour being the ease with which a stand is obtained under adverse conditions, and a short growth period of 100 to 110 days. Further, tepary bean (as also the soya bean) has an extremely useful characteristic in that it does not suffer severely from attacks of the large Cantharides beetle (C.M.R.). This is a serious pest in the area and is a definite limiting factor to yield with most beans of the *Phaseolus* group, the beetle often destroying all the flowers and preventing the setting of pods. Such varieties as the sugar bean and Canadian Wonder bean, with their open habit and exposed flowering systems, suffer severely in this way. When grown in rows 2' 8" apart, the tepary bean bushes out well and a large proportion of the pods are formed from flowers situated within the body of the plant, in positions which the beetle is not likely to frequent. This is of importance when considering spacing. In inter-row spacing trials the tepary has shown signs of ability to bush out and make use of space; results are not conclusive, but it is fairly certain that any slight yield advantage with a spacing of say 12" between rows would be discounted by loss from C.M.R. beetle attack. The reason is that, grown in close drills, the tepary bean develops an upright open habit, similar to the Sugar bean. Yields ranged from 1,600 lbs. in late December plantings to 560 lbs. in early February plantings.

MISCELLANEOUS CROPS.

Groundnuts.—A variety trial planted at the end of December gave the following yields of shelled-out nuts per acre:—Barberton strain, 1,388 lbs., Spanish 9, 1,067 lbs. and Japanese, 828 lbs. Yields of decorticated nuts are quoted owing to the dirty state of the pods, to which the red loam soil readily adheres. The incidence of "rosette" disease, which is felt to be a limiting factor, is being carefully observed from season to season.

The Imperial Institute reports that the Barberton strain would be readily saleably for oil crushing in the United Kingdom, if exported in the decorticated condition.

Phaseolus lunatus.—Observation plantings of the bush variety of Lima bean grown here previously were made on different dates. A planting made as late in the season as February 8th grew well and set a good crop. The probability is that the species will do best if planted towards the end of the rains. A range of strains has been procured from Burma and will be tried in the coming season.

Sunnhemp (Crotalaria juncea).—Grown for seed, sunnhemp yielded at the rate of 686 lbs. per acre.

Sorghum for silage purposes.—A broadcast of a white grained sorghum, Mapira, yielded at the rate of 10 tons of green matter per acre where the crop was not damaged by “witch-weed” (*striga lutea*). Occasional stray plants of this parasite have been observed in the vicinity of the Station from time to time, but it is thought that its appearance in some quantity in this isolated crop of sorghum may have been due to introduction in the seed.

Chick Pea (Cicer arietinum).—This yielded at the rate of 346 lbs. per acre from a broadcast plot.

Speckled Sugar Bean (Phaseolus sp.).—An observation plot of sugar beans, planted on 12th February, yielded at the rate of 400 lbs. per acre. The beans grew well vegetatively but the Cantharides beetle proved a limiting factor, destroying many flowers.

SUMMARY OF WORK ON COTTON INSECT PEST CONTROL.

BY

F. S. PARSONS.

Mr. E. O. Pearson joined the staff of the Insect Pest Control Section at the Cotton Station, Barberton, in November, 1931. Mr. Pearson has undertaken investigations on cotton stainers and has prepared the note on the season's work on stainers, given below.

PARASITE BREEDING WORK AND LIBERATION EXPERIMENTS.

Trichogramma lutea, Girault.—During the season the parasite has been bred only in such relatively small numbers as were required for laboratory and field experiments.

The foundation stock of parasite material procured for the season's work was bred out of American bollworm eggs collected off maize in the lower De Kaap Valley in September and October. The previous season's foundation stock was obtained in the same area about the same time of year. In the former season the multiplication of the parasite proceeded without difficulty in the eggs of various grain moth hosts. This season, however, it was impossible to get the parasite to oviposit, except rarely, in grain moth eggs (*Sitotroga*, *Plodia* and *Ephestia*), and the stock of *T. lutea* utilized for releases and in general was reared in cutworm eggs (*Euxoa segetis*, Schiff). Other *Trichogramma* stock for comparisons could not be obtained from the field, from various outside points, as natural parasitism was practically non-existent

throughout the season at the points and in the crops where collections could be made. In April, however, a few *Trichogramma* bred out of codling moth eggs were procured through Dr. Pettey of the Parasite Laboratory, Division of Plant Industry, Pretoria. These *Trichogramma* oviposited freely in grain moth eggs during the past winter.

Apparently different strains of the parasite exist in the area and these react differently to host material and to temperatures. The whole problem of exploitation of the parasite is therefore rendered more complicated, as a sorting out of strains for summer and winter season releases will probably be required.

Summer Season Release Experiments. These were carried out in cotton and maize on the Cotton Station, Barberton. These experiments were of a most intensive nature and were designed to afford much more complete sets of data on uncertain points, comprising, as they did, following through daily for some weeks the histories of all bollworm eggs oviposited on sample plants as drawn for recording purposes, together with a study of the situations in regard to surviving larvæ in the release and control fields concerned.

Many valuable, in fact essential, data were recorded in the course of these experiments, on such matters as the distribution on the plant of bollworm eggs, in regard to positions and pubescence in relation to the parasite's activity, the identity and activity of predators on eggs, ratios of egg populations to larvæ production and, of these, the larvæ attaining full growth, damage to the crops (in the case of cotton, shedding caused by bollworm and boll damage), and larval parasitism. From these data it was observed that egg deposition by *H. obsoleta* occurred, in the case of cotton, to the greatest extent on the larger plants dotted about the field; actually 8.3% of the plants carried 20.4% of the total eggs recorded and 34% of the plants carried 58% of the total eggs recorded. Correlation tables for size of plant and eggs laid give a correlation coefficient of $r=0.370$. On maize, egg deposition was, in comparison, evenly distributed.

The American bollworm moth appears to oviposit selectively on the larger (not necessarily on the most heavily fruiting) plants, which are probably chosen for shelter during the daytime. The information has a direct bearing on parasite releases in areas where adjacent cotton crops are in different stages of growth. If this knowledge had been acquired before, a ratooned trap crop area would not have been chosen for the release experiments, owing to the variation in plant growth in the particular crop utilized.

The dispersion of released *Trichogramma* by winds or otherwise is a factor which was not considered sufficiently in the choice of release

areas in these cases. In a release experiment in maize during a moderately heavy oviposition it was found that the parasites were carried, presumably by a steady South East breeze, into a control field some hundreds of yards distant. In this control field a rise of parasitism was recorded from nil to 42% of the surviving American bollworm eggs after one release (surviving eggs = eggs surviving the activity of predators, washed off, infertile, etc., before larval development of parasitism could be determined by daily observation), whereas in the release field parasitized eggs were very rare. As natural parasitism for some time previous was non-existent, the released parasites must have dispersed as found. The incubation periods of the parasitized eggs confirmed this view.

There was a decided lack of material to work upon during the course of the experiment in cotton, as egg-laying by both bollworms was on a much reduced scale in the weeks following the first examination for eggs and the initial release. The low infestation experienced at Barberton for the past two seasons has made it necessary to formulate programmes of work that may, if need be, be put into effect in other areas, notably Rhodesia.

In the cotton experiments, results in terms of parasitized eggs were negligible, comparatively speaking. In the maize experiments the most encouraging results were obtained in the case of parasitism in the check field mentioned above, into which parasites dispersed which were released in another field.

Under the circumstances, no conclusions may be drawn on the value of releasing laboratory-bred *Trichogramma* on cotton and maize during the summer season. The experiments were chiefly of value in indicating more clearly some, at least, of the real problems involved in the work and methods of approach thereto.

Future experiments require to be organised in connection with larger areas of crop.

The present summer season's programme of work will be confined largely to field experiments on *Trichogramma* releases.

Winter season release experiments.—In the aggregate a relatively large area of irrigated crops occurs throughout the district during the winter and spring months of the year. Most of these crops serve as host plants of the American bollworm, *Heliothis obsoleta*, Fabr., which feeds on them throughout those months, increasingly so as the weather becomes warmer towards October.

On the whole the annual irrigated crops (mainly vegetables) draw to a close about November. If suitable conditions occur cotton is of course sown in October and November and it is believed that

the American bollworm which attacks cotton and other rain-grown crops is derived very largely from bollworm which has been bred in irrigated crops in September, October and November.

Parasitism by *Trichogramma lutea* of the eggs of the bollworm moth was recorded during the first (1930) winter and spring survey of bollworm activity on the irrigated crops.

As a result of these observations it is considered that *Trichogramma* bred in the laboratory might be employed most usefully in the De Kaap Valley, and similar situations, to reduce potential bollworm on cotton by releasing the parasite extensively in the bollworm-breeding areas of the irrigated crops, because, briefly (1) the carry over of *T. lutea* through the coldest periods of the winter season is apparently very low. (2) apparently important differences exist at the various altitudes in the valley and in time of season (temperature) for the increase, from the slight beginnings of carry-over stock, of natural parasitism by *T. lutea*. As an example of this, in the lower, warmer valley natural parasitism has been evident sooner, has increased more rapidly, and has attained greater magnitude, over the whole, than elsewhere under observation in the valley during the past three years. (3) in the cooler, higher portions of the valley the weather has been warm enough for parasite breeding and activity in the Spring months, September, October and November, but it is believed that, under conditions of natural parasitism, the later start of breeding and multiplication from, probably, smaller numbers of carry-over stock, has meant, over the whole, a generally low maximum parasitism: consequently parasites released in quantity for colonization and additive purposes might be expected to build up a high percentage of parasitism quickly. (4) the vegetation in growth during the dry season is very largely confined to the irrigated patches of orchards and crops, consequently most material is concentrated.

Experimental releases of *Trichogramma lutea* were made during October 1931 and again during October and November 1932 in various irrigated crops in the neighbourhood of Barberton.

The experiments of 1931 were inconclusive. The present Spring season's work is still engaging attention, but the following remarks may be made in connection with a weekly release experiment in maize.

Natural parasitism was not observed in the district in many collections of eggs taken over some weeks in the immediate area of the experimental field, in the field itself, and in the surrounding neighbourhood, all different crops being sampled up to the time of the first release.

The first release was made on the 19th of October and four more releases were made later at weekly intervals. 9,600 parasites per acre were released on each occasion, the field being served equally each time over 6 blocks. The first samples of eggs for the determination of percentage parasitism were taken 7 days after the first release, and subsequently as shown below. Egg samples were taken from all parts of the field. The results up to the present are as follows :—

RELEASE FIELD.

<i>Dates of egg collections.</i>	<i>Eggs per plant.</i>	<i>Parasitism by T. Lutea. %</i>	<i>Parasitism by Phanrus sp. %</i>
19.10.32 (before 1st release)...	1 - 10	nil	—
26.10.32	1 - 10	8.5	—
3.11.32	0 - 12	23.8	1.1
11.11.32	0 - 3	50.0	—
16.11.32	0 - 10	42.0 (big increase in oviposition by <i>H. obsoleta</i> just before collection.	3.4
24.11.32	0 - 8	72.0	2.3

For check purposes samples have been drawn from tomato and maize crops, some hundreds of yards distant, and from fields of maize in different stages of growth on neighbouring farms. The maximum results up to the present are given below.

CHECK FIELDS.

	<i>Eggs per plant.</i>	<i>Parasitism %</i>	
		<i>T. lutea.</i>	<i>Phanurus sp.</i>
No. 1. Maize	1 - 15	29.0	—
„ 2. Tomato	0 - 4	2.8	—
„ 3. Maize	0 - 10	16.8	16.0
„ 4. Maize	1 - 12	5.2	1.0

In this instance the released *Trichogramma* have brought about a fairly high percentage of parasitism up to the time of writing and higher figures may be expected, whereas in outside areas natural parasitism is still low. That recorded in the check fields Nos. 1 and 2 may be due to dispersion out of the maize release field. The main object of employing *Trichogramma* in the irrigated crops would be to reduce the number of moths produced in these breeding areas well in advance of the cotton-growing season. Data accumulated in other experiments on the ratios of American bollworm eggs hatched to those oviposited on maize and the proportions of the surviving larvae which proceed as far as the pupal instar lead to the conclusion that

a total egg parasitism of 74% would mean a decided reduction in the number of pupations. In the present case larvae survival is still being studied.

In addition to the above, work has been carried out in the laboratory on the following :—

1. The cold storage of unparasitized and parasitized host eggs of *Trichogramma*.
2. Induced host preference.
3. Proportion of sexes in successive generations of *Trichogramma* bred in different host materials.
4. Vigour and distribution of size in progenies bred in successive generations of *Trichogramma* bred in different host materials.
5. Different strains of *Trichogramma*.
6. Questions of the value of feeding laboratory-bred *Trichogramma*, food materials and feeding methods.

Microbracon Brevicornis, Wesm.—*Breeding Methods*.—Mr. Ulyett has developed a technique for the production of the parasite in large numbers, utilising the larvæ of *Plodia interpunctella*, Hb. as a host.

Liberation Experiments.—Liberation experiments were undertaken against American bollworm, *H. obsoleta*, in maize crops on the Cotton Station. In these instances it appeared that a study of certain temperature and humidity relations in regard to the rapidity of putrefaction of larvæ paralysed by the parasite required to be made in the field and laboratory before the activity of released parasites could be evaluated.

Apparatus and methods were devised and successfully applied for this purpose before the season ended so that future field work with microbracon should proceed more satisfactorily.

Phanurus nov. sp. (?).—The parasite B, referred to in the report of last year has been identified as a species of *Phanurus* (*Scelionidae*).

In view of information on the activity of the species as a parasite of the egg of the American bollworm, during the cool season, attempts have been made to breed it on a large scale. Up to the present time these attempts have been unsuccessful. A multiple temperature incubator which has now been constructed may enable this work to be conducted to better advantage.

BOLLWORMS.

Investigations on the pupal stage of the Red Bollworm in cotton lands.—Data have been recorded from excavations on the natural distribution of pupæ in fields of growing cotton from December to April inclusive. This work is in continuation of the preliminary

investigations on the use of implements when employed for the purpose of destroying pupæ by direct and indirect means, referred to in last year's Summary.

Season Infestation Records of Bollworm Activity.—Red Bollworm.—Records were obtained throughout the season at Barberton and, with the co-operation of Mr. Bowmaker, Mr. Lochrie and Mr. Inglis, at Magut, Natal, and at points in Swaziland.

In the districts concerned red bollworm activity in general was much reduced over former years.

American Bollworm.—Records for the summer season were obtained at the points referred to above.

A report was received from Magut of heavy damage to cotton in March by American bollworm. No heavy attacks were reported from Swaziland.

A heavy infestation occurred on maize at Barberton, one generation on early maize in January (which was utilized for experimental releases of *microbracon*) and three generations, on later maize in February, March and April. The pest did not occur to any appreciable extent on adjoining cotton, possibly because the land under maize on the Station was more extensive than usual and the crops on different fields came into silking in a serial manner. The summer season records at Barberton were confined to the Cotton Station for reasons of economy.

Records were taken on American bollworm infestation from May, 1932 to November, 1932 (the cool and Spring season months) on irrigated crops in the De Kaap Valley, round about Barberton, in continuation of previous records. The data are required in connection with information on the sources of American bollworm infestations on cotton, records of natural parasitism in the off season of cotton-growing, and parasite releases amongst the irrigated crops, as designed, to reduce the quantity of bollworm coming into cotton crops from the areas of irrigated crops.

Seasonal Incidence of egg and larval parasites of Red Bollworm and American Bollworm. Records of natural parasitism.—The records were undertaken at Barberton, at Magut, Natal, and at Bremersdorp and Ingwavuma in Swaziland in continuation of previous records. No cases of egg parasitism were found amongst cotton crops throughout the season, except one doubtful case in Swaziland. The work in areas outside Barberton was unfortunately confined to cotton crops only. In future seasons it is hoped that observations may be made in maize and bean crops as well.

Parasitism of red bollworm larvæ at Barberton was only observed in material collected off cotton bollworm trap crop areas. The

percentage parasitism was always low. The only parasites recorded were *Apanteles diparopsidis*, Lyle, and an unidentified *Tachinid* (our No. 1044) which is present in the Northern Transvaal also. No cases of parasitized red bollworm larvæ were observed at Magut or in Swaziland.

American Bollworm larval parasites.—A first record of one other Dipterous larval parasite was made in larvæ collected off maize plants in January at Barberton. 27% of this, the first generation of the worm on early maize, this season, was parasitized by this fly. 41% of the same generation was parasitized by the Tachinid, *Sturmia inconspicua*. In a later generation at Barberton the parasitism by *S. inconspicua* was 14%.

Sturmia inconspicua was recorded also at Magut as giving rise to a 20–30% parasitism during a heavy infestation there on cotton in March.

As in former seasons, *S. inconspicua* has been the most important parasite of American bollworm larvæ. No larval parasites were observed in Swaziland collections.

Some preliminary work on the biology and breeding of *Sturmia inconspicua* has been accomplished.

COTTON STAINERS.

Alternative Host Plants.—In order to determine the nature and abundance of possible wild host plants of stainers, an ecological survey of the Malvaceous and Sterculiaceous flora of the district has been undertaken. This shows the presence of :—

- (i) A large number of species of herbaceous plants, rarely carrying stainers in quantity, but probably providing sufficient food to support an exiguous population right through the year.
- (ii) A number of extensive colonies of *Sterculia* trees (*S. rogersi* and *S. murex*, the former much the more abundant), bearing open fruit between November and February, providing a breeding place in this period for two to three generations of stainers, the final population being extremely large but disappearing from the trees about the time that the first migrant stainers appear in plant cotton. Colonies of trees of this genus, occurring in ecologically well-defined situations, have been observed in the following localities :—(a) The De Kaap Valley. (b) The Low Veld of the Eastern Transvaal and Portuguese East Africa. (c) The Mopani-Baobab association of the Limpopo basin. (d) The similar association of the Zambesi basin.

Infestation Records on the Cotton Station, Barberton.—The first migrants from the veld appeared in the most advanced fields of plant cotton in early March and from then onwards a daily count was made over the whole Station by a native observer following a diagonal route across each of the 24 fields ($2\frac{1}{2}$ acres each), recording the number of adult stainers on one plant in every alternate row. This gives an approximately one per cent. sample. The initial migration was small compared with that of the previous season, a peak density of 4,000 per acre being reached, compared with 14,000 per acre last season. This peak fell on April 7th. The earliest fields produced a clean early crop and good seed.

The F_1 was extremely large, however, reaching a peak density of 20,000 per acre, averaged over the whole Station, on May 9th, the full force of this being felt by the late planted and re-planted cotton, which was badly stained and gave a high percentage of bad seed.

The bulk of the cotton was cut out during the latter part of June and early July, stacked in heaps for a week and then burnt. Most of the fields were ploughed very shortly afterwards. As a clean-up measure this has been completely effective.

Identity of Stainers.—Three species are found in the Barberton district: *D. fasciatus* Sign., *D. nigrofasciatus* Stål and *D. intermedius* Dist. Of these the last is rare, never comprising more than 4% of the total population on the Station in the season under review, although it was abundant on Premier Cotton Estates, Portuguese East Africa. *D. nigrofasciatus* was commoner than *D. fasciatus* in the veld and constituted the bulk of the first migration to plant cotton, but its reproductive rate on cotton was much lower, the migrant population giving rise to a five-fold F_1 as against a fifteen-fold increase on the part of *D. fasciatus*. This is in agreement with observations in previous years. *D. fasciatus* must be regarded as responsible for the greater part of the damage to the main crop.

The Spread of Infection in Cotton.—The alternative host plants and insect vectors of internal boll disease are being investigated. Ratoon cotton early in the season (December to January) shows a considerable degree of staining before any *Dysdercus* appears. The infection appears to be carried by a number of Heteroptera, largely Pentatomidae, for whose other host plants, which include several legumes, a search is being made. Tests are also being made to discover whether stainers living on wild hosts in the early summer are carrying infection.

The ultimate effectiveness of the stainer in reducing the yield of clean cotton depends on a complex of factors which are

being separately investigated. Those on which work has started include :—

1. The ability of a given instar to pierce the wall of a boll of given age.
2. The attractiveness of bolls of different ages to different instars and their efficiency as a source of food for maintenance, growth and reproduction.
3. The rate of growth of the fungi in bolls of different ages.

BARBERTON.

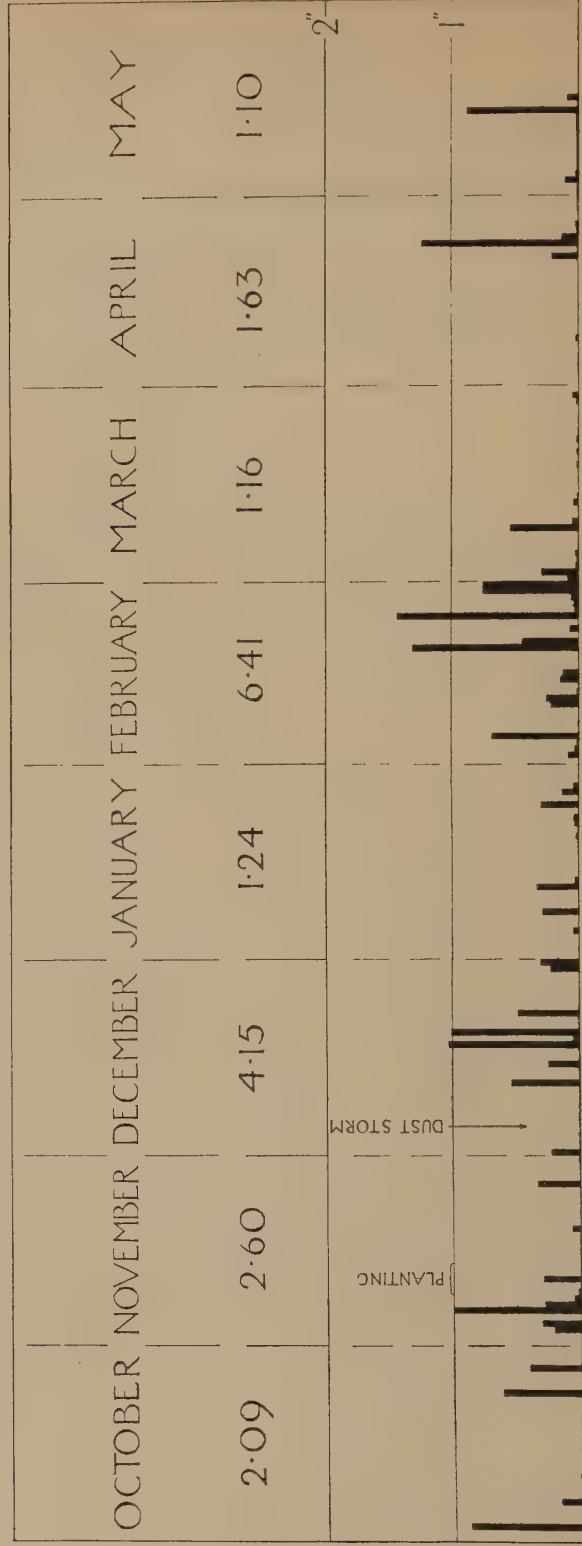
DAILY RAINFALL, SEASON 1931-32.

	<i>July.</i>	<i>Aug.</i>	<i>Sept.</i>	<i>Oct.</i>	<i>Nov.</i>	<i>Dec.</i>	<i>Jan.</i>	<i>Feb.</i>	<i>Mar.</i>	<i>Apr.</i>	<i>May</i>	<i>June</i>
1 ...	—	—	—	—	—	0.22	—	—	0.08	—	—	0.04
2 ...	—	—	—	—	—	—	—	0.08	0.29	—	—	—
3 ...	—	—	—	0.88	0.22	—	—	0.03	0.02	—	0.11	—
4 ...	—	—	—	—	0.31	—	—	0.01	0.01	—	0.02	—
5 ...	0.04	—	0.12	—	—	—	0.05	0.68	0.02	—	—	—
6 ...	0.05	—	—	—	0.99	—	—	—	—	—	—	—
7 ...	0.72	—	—	0.17	0.29	—	—	—	—	—	—	—
8 ...	—	—	—	—	0.06	—	0.29	—	—	0.02	—	0.18
9 ...	—	—	—	—	0.02	—	—	—	0.54	—	—	—
10 ...	0.09	—	—	—	—	—	—	0.22	0.05	—	—	—
11 ...	0.02	—	—	0.01	0.30	—	—	0.25	—	—	—	—
12 ...	—	—	—	—	—	0.54	0.33	0.01	—	—	—	—
13 ...	—	—	—	—	—	—	0.03	—	0.04	—	—	—
14 ...	0.12	—	—	—	—	—	—	0.14	0.01	—	0.88	—
15 ...	0.04	—	—	—	—	0.25	—	0.12	—	—	—	—
16 ...	—	—	0.01	—	—	—	—	—	—	—	0.09	—
17 ...	—	—	—	—	—	—	—	—	—	—	—	—
18 ...	—	—	—	—	—	1.04	—	—	—	—	—	—
19 ...	—	—	—	—	0.07	0.06	—	1.31	0.01	—	—	—
20 ...	—	—	—	—	—	1.01	0.01	0.43	—	—	—	—
21 ...	—	—	—	—	—	—	—	—	0.01	0.21	—	—
22 ...	—	—	—	—	—	—	0.03	0.07	—	—	—	—
23 ...	0.03	—	—	—	—	0.49	0.03	—	0.01	1.24	—	—
24 ...	0.02	—	—	0.62	—	—	—	1.43	—	0.13	—	—
25 ...	0.03	—	—	—	—	—	0.30	0.03	—	0.01	—	—
26 ...	—	—	—	—	0.34	—	—	0.04	—	0.02	—	—
27 ...	—	—	—	—	—	—	0.13	0.06	—	—	—	—
28 ...	—	—	—	0.41	—	—	0.04	0.75	—	—	—	—
29 ...	—	—	—	—	—	—	—	0.75	0.02	—	—	—
30 ...	—	—	—	—	—	0.23	—	—	0.05	—	—	—
31 ...	—	—	—	—	—	0.31	—	—	—	—	—	—
Total ...	1.16	—	0.13	2.09	2.60	4.15	1.24	6.41	1.16	1.63	1.10	0.22

Total rainfall for year, 21.89 inches.

BARBERTON.

DAILY RAINFALL. SEASON 1931-32.



REPORT ON THE WORK OF THE COTTON EXPERIMENT STATION, MAGUT, NATAL FOR THE SEASON 1931-1932.

SUMMARY OF RESULTS.

BY

P. A. BOWMAKER.

INTRODUCTION AND SUMMARY.

The season 1931-32 was the most difficult from an arable farming point of view since settlement of the Magut district was commenced. An exceptionally dry winter left a negligible amount of subsoil moisture, and planting rains were not sufficient to give good germinations and early growth. The effect of the lack of moisture was felt until late in January, after which growing conditions were very good indeed. The nature of the rainfall is shown in the diagram at the end of the Report.

To a lesser degree such a distribution of rainfall is fairly common, but the need for suitable rotation crops to use with cotton has been borne out very strongly this season. Preparation of land was delayed by the weakness of draught oxen after six months of drought, and by the time they had recovered sufficiently the season was too far advanced to allow of planting cotton. Thus a larger proportion of land was devoted to other crops than would have been the case had the winter been less severe.

The work on the Station consisted of variety tests of the newer strains from U.4 evolved at Barberton, various cultivation trials with cotton, and multiplication areas of the new strains. Observations on the numbers of bollworm and stainer were made throughout the season. Work on other crops consisted of variety tests, cultivation trials and general observations on maize, soya beans, groundnuts, Lima beans, Tepary beans, wedge pea and sunflower. A permanent rotation experiment was laid down for the purpose of assessing definitely the comparative effects of various rotation crops on subsequent cotton crops, and for the same purpose an experiment was begun to compare two types of green manure and bare fallow: A certain amount of selection work is being carried out with maize, as it is considered that if a more drought-resistant variety of white maize

can be evolved, the cost of feeding native labour for arable farming in the district will be very greatly reduced, with a consequent improvement in the acreage under cultivation. Owing to the lower cost of labour involved there is a tendency for farmers to think more of stock farming than of arable work, and a reliable variety of maize, would not only be a suitable crop to grow in rotation with cotton, but should go a long way towards reducing costs of cotton production and arable farming generally.

COTTON EXPERIMENTS.

Variety Tests.—A variety test in three sections was laid out early in November for the comparison of eighteen strains selected from U.4 with each other and with U.4 Mixed Bulk. The randomized block arrangement was adopted, the plots being 1/80th acre with eight replications of each strain. Great difficulty was experienced during December in keeping the plants alive, hand watering being resorted to on three occasions. Heavy growth was made after the rains in February, and a good potential crop was in view. In April, however, a devastating attack of American bollworm so reduced the crop that it was decided that comparative yield figures would have no value.

Cultivation Trials.—Cultivation trials, consisting of a subsoiling experiment and “barring off”, were even more disappointing than the variety tests. As in that experiment, very heavy growth resulted after the rains in February, and the crop was almost entirely lost through American bollworm. No effects of treatment were noted in either of these trials.

Multiplication areas.—A small quantity of seed of each of the re-selections from Barberton was available for multiplication purposes, and this was hand-planted late in December at the rate of one seed to the square yard. Owing to poor germinating conditions a bad stand was obtained, and the crop was lost in April. The very wide spacing, however, permitted of a new growth in May, and fair amounts of seed were reaped in September.

ROTATION CROPS.

Maize.—Progress with maize, a crop which should play an important part in agriculture in the district, has been seriously hampered in past seasons by the frequent failure of the crop through drought. It is thought that this has been due in some measure to the unsuitability of varieties or strains of these varieties to the uncertain climatic conditions, and work this season has been carried out to improve

certain kinds known to be drought-resistant in other districts. American White Flint and Peruvian Yellow offered good material, and an effort is being made to reduce the proportion of very small grain in the former by selection, and at the same time to increase its yielding powers and hardness. A number of types are to be purified to a certain degree.

The varieties grown included White Wisconsin, Anveldt, Peruvian Yellow, American White Flint and 60-day White Flint. Observations on the growth of these indicate that, given fairly good rains such as were experienced on the Station during the latter half of the season, the varieties giving larger grain are preferable to the flints. Under reasonably good climatic conditions any variety is capable of giving up to 3,000 lbs. per acre on most soils in the Magut area, and pending results in the improvement of the American White Flint, this fact prompts the following recommendation which will apply to any variety. A planting season of about three months is available, during which there are usually three or four opportunities for planting. It is thought that better results will be obtained in the long run if the land to be under maize is divided into several portions one of which is sown with each rain.

Addition of a heavy dressing of Superphosphate gave an increase of 850 lbs. of Peruvian Yellow maize, the yield of the untreated plots being 1,760 lbs. per acre.

Soya Beans.—The crop planted for bean production was practically a failure. It was sown early in February, which generally speaking would be rather late in the season, and almost ideal growing conditions followed. Possibly the type of root system formed was not suited to the dry spell in April, but at the time when good soil moisture conditions should have been present for filling the seed, a dry period was encountered resulting in premature ripening and death of the plants.

For hay production two spacings were compared, 24" $\times$ 6" and 12" $\times$ 6", the yields of green matter and hay respectively being as follows :—

Date.	Green weight yield. lbs. per acre.		Air-dried hay. % of green wt.
	12" $\times$ 6"	24" $\times$ 6"	
21/3	13,860	10,260	21.6
28/3	11,340	9,180	27.2

It is thought that given slightly less favourable conditions for growth the yields would be considerably smaller.

Groundnuts.—A variety test of the most promising lots of groundnuts gave the following yields in lbs. per acre :—

<i>Strain.</i>	<i>Straw.</i>	<i>Unshelled nuts.</i>	<i>Shelled nuts.</i>	<i>Shelling %.</i>
Japanese	1,022	528	338	64
Barberton	927	656	363	55.4
Spanish 9	955	687	421	61.3
Natal	1,047	735	438	59.6

The varieties mentioned give a small two-seeded nut which does not command the highest price for the purpose of human consumption. The Virginia Bunch variety, while it gives a more desirable quality for this purpose, has not given the same yields in past seasons as the strains included in the variety test. A small area was planted and gave a yield of 465 lbs. per acre of unshelled nuts, with a shelling percentage of 70.5.

From the behaviour of groundnuts during the last two seasons they are considered one of the most promising rotation crops for the Magut district. Very little trouble has been caused so far by Rosette disease, the limiting factor in the established groundnut-growing areas.

An experiment comparing ridging with ordinary flat cultivation gave no difference in yields due to treatment.

Lima Beans.—A block of Lima beans was planted early in February for general observation purposes. It appears to be quite suited to the conditions of the district, but is susceptible to heavy loss from the C.M.R. beetle. No pod shedding, such as has been reported from Barberton, was observed, but during April a heavy loss of potential crop was brought about by the poor moisture conditions. Root development was inadequate owing to the frequent rains in the growing period. A later crop was set and matured.

The only control for the C.M.R. beetle which has been suggested so far is hand collection. This may be facilitated by taking advantage of the habit of the beetle of collecting in masses in a semi-dormant state in the early morning and evening on some tall growing plant. A small quantity of Sunn Hemp mixed with the Lima bean provides a counter attraction, and renders hand collection easier.

Tepary Beans.—Tepary beans continued to give good results. Planting before the New Year is not to be recommended, as there seems to be greater susceptibility to a leaf curl disease, if planted earlier.

No accurate spacing trial was conducted, but various spacings were used in blocks, the yields of which are given below.

<i>Spacing.</i>	<i>Yield in lbs. per acre.</i>	<i>Note.</i>
12" × 6"	1,728	} Comparable.
24" × 6"	1,329	
18" × 6"	1,203	} Comparable.
36" × 6"	955	

Under abundant moisture conditions the close spacing is desirable.

The crop was planted early in February, and matured in eleven weeks. No change in the maturation period could be attributed to width of spacing. A small experiment was designed for observations on close-spaced tepary beans for forage purposes. The weights obtained are shown in the table below, and may be compared with the forage soya bean yields given previously. Planting was carried out on 7th February.

<i>Date.</i>	<i>Green weight in lbs. per acre.</i>		<i>Air-dried hay % of green wt.</i>
	12" × 6"	24" × 6"	
21/3	15,300	13,140	19.0
28/3	14,940	11,700	23.7

Sunflower.—A spacing trial again gave no significant difference in yield between the spacings adopted. There was, however, a marked difference in quality, the widest spacing (36" × 36") giving the largest, best filled seed. Two varieties were grown, Bremersdorp Black, and Striped, there being no appreciable difference in yield. The maturation period of the Black as before was about three weeks longer than of the Striped, a disadvantage where distribution of rainfall compels late planting. Planting took place in February, and uniform yields of 930 to 960 lbs. per acre of seed were taken.

Wedge Pea.—Very poor early growth characterised the crop, with a good recovery later brought about by the rainfall in May. Poor yields of peas for which there is little demand were obtained, and this combined with its general poor response to conditions in the district lead to the conclusion that its possibilities as a rotation crop are poor.

Sunn Hemp.—There is a small but good market for Sunn Hemp seed for a green manure crop, and experience has shown that it may be grown profitably in the Magut area. A spacing trial for seed production was laid out. A comparison of 12", 24" and 36" in the rows, with rows 32" apart, gave 591, 649 and 687 lbs. per acre respectively, and it is thought that in a less favourable growing season there would be greater advantage in adopting the wide spacing.

Rotation Experiment.—So far very little is known of the comparative effect of the various possible rotation crops on subsequent cotton yields, and to this end an experiment was laid down. A block of four acres was planted to maize, sunflower, soya bean, groundnuts, and sunn hemp for green manuring. The land was divided into five portions, each being treated as a randomized block with the above crops.

In addition to the effect of these crops on subsequent cotton yields, the layout permits of observations being made on the effect of each of the rotation crops on each of the others.

Green Manuring.—Before the slump in cotton prices an increasing interest was being shown in the district in green manuring and soil improvement generally. An experiment was laid down to compare the effects of Sunn Hemp and Sword bean as green manures and of a bare fallow on succeeding crops of cotton and maize.

INSECT CONTROL.

American and Sudan Bollworm.—As the problems which present themselves in connection with bollworm control are similar at Magut and Barberton, no work of fundamental importance was carried out; facilities and personnel for work of this kind are not available at Magut. For collaboration purposes records were taken throughout the season of worm and worm parasite population.

*Stainer (*Dysdercus* spp.).*—Stainer work was confined to daily records of numbers present, for use at Barberton.

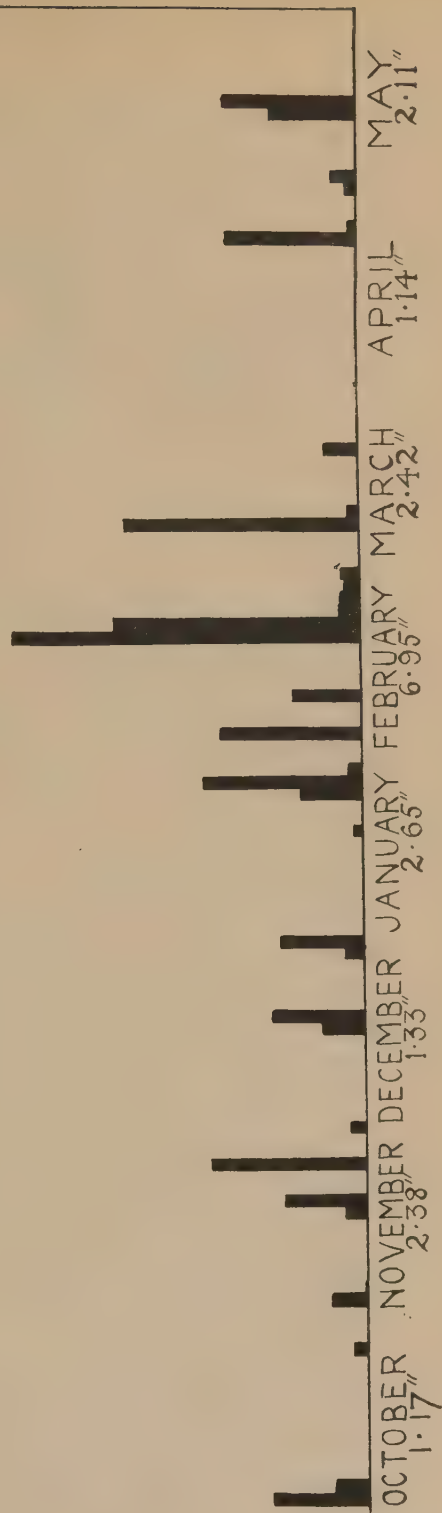
*Beetle (*Syagrus rugifrons*).*—General emergence of the beetle was noted to take place early in December. It is thought that there is a connection between emergence and the spring rains, as late rains are followed by a late appearance of the beetle.

The method of control which has been previously suggested in these Reports has proved quite satisfactory here.

MAGUT EXPERIMENT STATION, SEASON 1931-1932.

RAINFALL IN TWO-DAY TOTALS.

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SWAZILAND

REPORT ON THE WORK OF THE COTTON EXPERIMENT STATIONS AT BREMERSDORP AND INGWAVUMA FOR THE SEASON 1931-1932.

SUMMARY OF RESULTS.

BY

J. V. LOCHRIE.

GENERAL.

Climatic Conditions.—With the exception of the area in the neighbourhood of the Bremersdorp Station the season was very similar to the previous one. In practically all districts no effective rains fell until late November, and the consequent delay in ploughing accounts, in part, for the decrease in the acreage planted to the cotton crop. During the growing period the rainfall was low with consequent poor plant growth and final yields were well under the average of previous seasons.

In South Swaziland, *i.e.*, the area served by the Ingwavuma Station the position was even worse, as no effective falls were recorded until mid-December. Plantings were completed on these falls, but the protracted dry period which followed coupled with a series of dust-storms practically wiped out the plant cotton. A good percentage of the cotton in the area consisted of ratoons, but little crop was picked. Under the low rainfall conditions the ratoon plants made little growth, and bollworm attack, though not so severe as in the previous season, still further reduced the yields.

Pests and Diseases.—Bollworm was present in all areas throughout the season the attack being highest in the South Swaziland area. As in the previous year, Sudan bollworm (*Diparopsis castanea*) was of principal importance. The incidence of the American bollworm (*Chloridea obseleta*) was comparatively small and was confined to the early part of the season.

Stainer (*Dysdercus spp.*) made its appearance in small numbers in all districts in early March, but the pest was of comparatively minor importance except on the irrigated cotton in South Swaziland. In this irrigated cotton stainer was present in numbers throughout the season and very little undamaged cotton was harvested.

EXPERIMENT STATIONS.

Bremersdorp.—The station area was the most fortunate as far as rainfall is concerned, the total recorded for the year being 30 inches.

Good falls were experienced in July and in early October and these enabled the land to be ploughed and prepared for planting. Further rain fell in early November and the whole of the crop was planted by 9th November. Germination was good and the first plantings in particular got away well. Growth conditions during the season were good and, with comparative freedom from pests, good yields were obtained. The average yield on the farm on which the station is situated was approximately 1400 lbs. per acre, with one field yielding just over three bales of seed cotton per acre.

Ingwavuma—Dry Land.—Owing to the late arrival of the rains, no planting could be done until mid-December and during a series of duststorms, in the drought which followed, the stands of all the experimental plots were ruined. The season was too far advanced for re-planting, and the area was planted with beans.

Irrigated.—It had been decided to duplicate some of the cotton experiments under irrigation conditions, but, owing to the drying up of the river, planting was delayed for nearly four weeks. Bollworm attack was fairly heavy, especially during the early part of the season, but the major pest was stainers. These were present early in neighbouring fields of ratoon cotton, and by April the numbers had increased to such an extent that practically no clean cotton was harvested.

Variety Tests.—Last season's trials, using the same strains and plot layout, were repeated this year at Bremersdorp and at Ingwavuma.

With some marked differences, such as the failure of 9275 compared with its performance the previous year, the strains at Bremersdorp mainly followed the behaviour of the previous season. Strains 9243, 920 and 921 again showed up well, while the early types, 998 and 955, were more successful this year.

Under irrigation, no yield data were obtained, owing to stainer damage, but counts of bolls on groups of plants in each plot were made. For this season's conditions these counts indicate the superiority in boll production of the early strains such as 955 and 998, and the failure of 9275 and 9274.

Spacing.—The experiment carried out last year to test the effect of different spacings on two strains (*a*) a small early type and (*b*) a later and more vigorous strain was repeated at Bremersdorp. Growth on this section of the station was not good and yields were far below the station's average.

Another experiment combining different spacings and times of thinning gave a yield all over of 1400 lbs. seed cotton per acre, but with no significant differences in yield between the various spacings or times of thinning.

Rotation Effect.—A series of randomised plots was laid out in the previous season with the object of comparing the effect on a cotton crop of previous rotation crops. The treatments used were bare fallow, buckwheat ploughed in, sunnhemp ploughed in, beans, maize and groundnuts, the last three being harvested. The acreage yield over the experiment was over 1,400 lbs. seed cotton, but on analysis there was no significant difference in yield between any of the treatments. The great difference between the treatments was in the early growing period as the plots following fallow and buckwheat made very poor growth in the first part of the season. This delayed growth and development was noticeable until February. These treatments came up in the later pickings, but it is considered that in a short season such as 1930–1931 they would have suffered in yield.

Fertiliser Experiment.—An experiment was carried out to test the effect of various fertilisers on cotton. The treatments were Superphosphate (250 lbs. per acre), Bone Flour (150 lbs.), Muriate of Potash (150 lbs.), Bone Flour and Potash (150 lbs. of each) and Unfertilised. The yield over the 12 acres of the experiment exceeded 1,500 lbs. seed cotton per acre. An analysis of the results shows no significant differences in yield between the various treatments, though in all plots receiving phosphate the yields were higher than in those which received no phosphate. In this connection it must be noted that the field on which the experiment was conducted had been under maize, fertilised with Bone Flour, in the preceding season. As regards Potash, no appreciable differences in yield were obtained due to its use. The experiment will be carried on with an increased number of replicates.

ROTATION CROPS.

Bremersdorp.—While the season was satisfactory as far as the cotton crop was concerned, it was not so good from the point of view of the rotation crops. Early planted maize in the neighbourhood suffered from lack of moisture during December and January and gave little yield, but good crops were obtained from the later plantings. On the station the most successful crops were groundnuts and a non-shattering yellow soya.

In a variety test of groundnuts the results confirmed those of last year. The Spanish variety was superior to all the other strains giving a yield of nearly 600 lbs. of shelled nuts per acre in spite of

a rather low kernel percentage. The same variety in observation plots planted two weeks earlier gave yields of over 900 lbs. per acre. Of the other types planted the best were Japanese and a Java type.

Various types of beans were again tried—the range included Soyas, Limas and Speckled Sugar beans—but except for the early plantings the yields were low. A strain of non-shattering Soya was the most successful giving a yield of 1,100 lbs. per acre against 650 lbs. of Limas and 500 lbs. of Speckled Sugars. The latter never yield highly, but are grown as they are in demand and sell for the highest price on the local market. It is intended to continue work on these beans along the lines of time-of-planting, spacing and fertilising.

Ingwavuma.—Encouraging results have been obtained with several rotation crops under irrigation conditions. Of the beans the most successful have been Canadian Wonder and a small haricot. Plantings were made during summer, and also in June for winter trials, and in each case the winter-grown beans gave the highest yields. In addition, the beans were a much better sample from the winter-grown plots. Maize also has given promising yields and the method adopted now is to take a crop of maize during the summer and to plant the land to beans in winter.

A variety test of groundnuts was laid out using the same varieties as at Bremersdorp. The Spanish variety was the most successful and was significantly better than any of the others. The acreage yield of the Spanish was just on 1,300 lbs. of shelled nuts.

BREMERSDORP.

DAILY RAINFALL—SEASON 1931-32.

<i>Date.</i>	<i>July.</i>	<i>Aug.</i>	<i>Sept.</i>	<i>Oct.</i>	<i>Nov.</i>	<i>Dec.</i>	<i>Jan.</i>	<i>Feb.</i>	<i>Mar.</i>	<i>Apr.</i>	<i>May.</i>	<i>June.</i>
1 ...	—	—	—	—	—	0.60	0.20	—	—	—	0.31	—
2 ...	—	—	—	—	—	—	—	—	0.39	—	0.11	—
3 ...	—	—	—	1.06	0.90	0.09	—	0.04	0.04	—	0.55	—
4 ...	—	—	—	—	0.25	—	—	—	—	—	0.11	—
5 ...	0.01	—	—	—	—	—	0.66	—	—	0.02	—	—
6 ...	—	—	—	—	0.52	—	0.03	—	—	—	—	—
7 ...	1.12	—	—	—	0.28	—	—	—	—	—	—	—
8 ...	0.03	—	—	—	—	—	—	—	1.74	0.18	—	0.77
9 ...	—	—	—	—	—	—	—	—	0.47	—	—	—
10 ...	—	—	—	—	—	—	—	1.25	0.37	—	—	—
11 ...	—	—	—	—	—	—	—	0.09	—	—	—	—
12 ...	—	—	—	—	—	0.65	0.44	—	—	—	—	—
13 ...	—	—	—	—	—	0.42	0.03	—	—	—	0.29	—
14 ...	0.07	—	—	—	—	—	—	—	—	—	0.38	—
15 ...	0.45	—	—	—	—	—	—	—	—	—	0.13	—
16 ...	—	—	—	—	—	—	—	—	—	—	0.30	—
17 ...	—	—	—	—	—	0.06	—	—	0.03	—	0.02	—
18 ...	—	—	—	—	—	0.15	—	—	—	—	—	—
19 ...	—	—	—	—	0.44	—	0.29	0.96	0.70	—	—	—
20 ...	—	—	—	—	—	1.31	0.03	0.49	0.05	—	—	—
21 ...	—	—	—	—	—	—	0.07	1.42	0.25	0.02	—	—
22 ...	—	—	—	—	0.12	—	—	0.02	—	0.78	—	—
23 ...	0.03	—	—	—	—	0.12	—	—	—	—	—	—
24 ...	—	—	—	0.52	—	—	—	1.24	0.01	—	—	—
25 ...	0.07	—	—	—	—	—	0.59	0.79	—	0.02	—	—
26 ...	—	—	0.16	—	0.45	—	0.13	0.34	—	0.09	—	—
27 ...	—	—	—	—	—	—	0.11	—	—	0.31	—	—
28 ...	—	—	—	0.72	—	—	0.11	0.11	—	0.08	—	—
29 ...	—	—	—	—	—	—	—	1.09	—	0.09	—	—
30 ...	—	—	—	—	—	0.34	—	—	—	—	—	—
31 ...	—	—	—	—	—	—	—	—	—	—	—	—
Total ...	1.78"	Nil	0.16"	2.30"	2.96"	3.74"	2.69"	7.84"	4.05"	1.59"	2.20"	0.77"

Total for year = 30.08 inches.

INGWAVUMA (NSOKO).

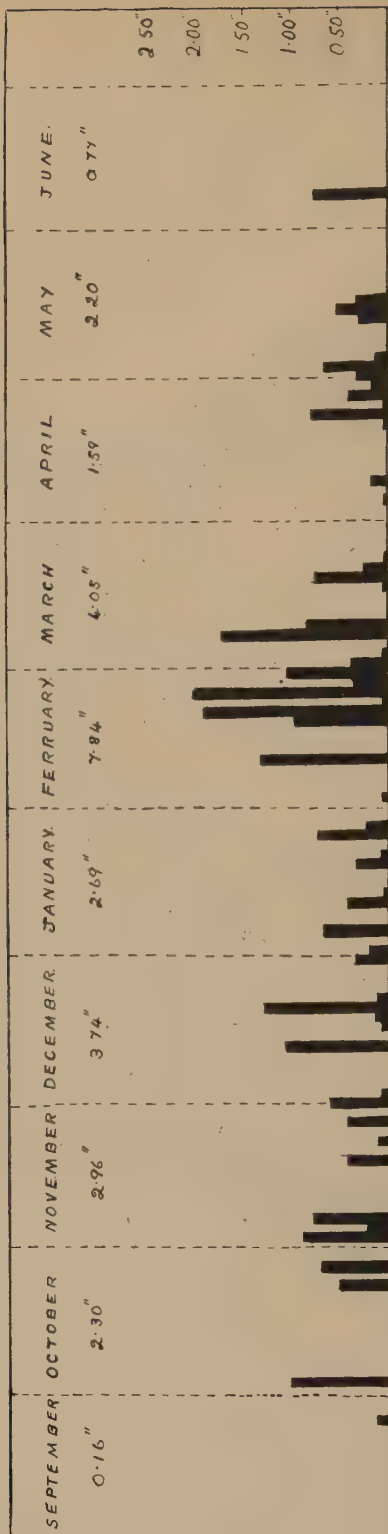
DAILY RAINFALL—SEASON 1931-1932.

<i>Date.</i>	<i>July.</i>	<i>Aug.</i>	<i>Sept.</i>	<i>Oct.</i>	<i>Nov.</i>	<i>Dec.</i>	<i>Jan.</i>	<i>Feb.</i>	<i>Mar.</i>	<i>Apr.</i>	<i>May.</i>	<i>June</i>
1 ...	—	—	—	—	—	0·07	—	—	0·02	—	0·07	—
2 ...	—	—	—	—	—	—	—	—	—	—	0·04	—
3 ...	—	—	—	0·95	0·11	0·01	—	—	0·02	—	0·28	—
4 ...	—	—	—	0·01	0·07	—	—	—	—	—	0·15	—
5 ...	0·05	—	0·02	—	—	0·56	—	0·09	—	—	0·03	—
6 ...	—	—	—	—	—	—	—	0·02	—	—	0·01	—
7 ...	0·56	—	—	—	0·02	—	—	—	—	—	—	—
8 ...	0·02	—	—	—	—	—	—	—	1·21	0·42	—	—
9 ...	—	—	—	—	—	—	—	—	0·94	0·08	—	—
10 ...	—	—	—	—	—	—	—	0·04	0·02	—	—	—
11 ...	—	—	—	—	—	—	—	—	—	—	—	—
12 ...	—	—	—	—	—	0·02	—	0·01	—	—	—	—
13 ...	—	—	—	—	—	—	—	—	—	—	0·11	—
14 ...	0·01	—	—	—	—	—	—	—	—	—	0·95	—
15 ...	0·01	—	—	—	—	0·40	—	—	—	—	0·02	—
16 ...	—	—	0·02	—	—	—	—	—	—	—	0·33	—
17 ...	—	—	—	—	—	—	—	—	—	—	0·01	—
18 ...	—	—	—	—	—	2·49	—	—	—	—	—	—
19 ...	—	—	—	—	0·62	—	0·02	0·03	0·32	—	—	—
20 ...	—	—	—	—	0·19	0·19	0·70	0·01	0·01	—	—	—
21 ...	—	—	—	—	—	—	—	0·29	0·04	—	—	—
22 ...	—	—	—	—	—	—	—	0·03	—	—	—	—
23 ...	—	—	—	—	—	—	—	—	—	1·07	—	—
24 ...	—	—	—	0·21	—	0·01	—	0·03	—	0·01	—	—
25 ...	—	—	0·01	—	—	—	0·36	0·15	—	0·64	—	—
26 ...	—	—	0·08	—	—	—	—	0·02	0·05	0·18	—	—
27 ...	—	—	—	0·01	—	—	—	—	—	0·07	—	—
28 ...	—	—	—	0·31	—	—	0·23	—	—	—	—	—
29 ...	—	—	—	0·03	—	—	0·13	0·09	—	0·01	—	—
30 ...	—	—	—	—	—	0·10	—	—	—	0·01	—	—
31 ...	—	—	—	—	—	—	—	—	0·02	—	—	—
Total ...	0·65"	Nil.	0·13"	1·52"	1·01"	3·85"	1·44"	0·81"	2·65"	2·49"	2·00"	Nil.

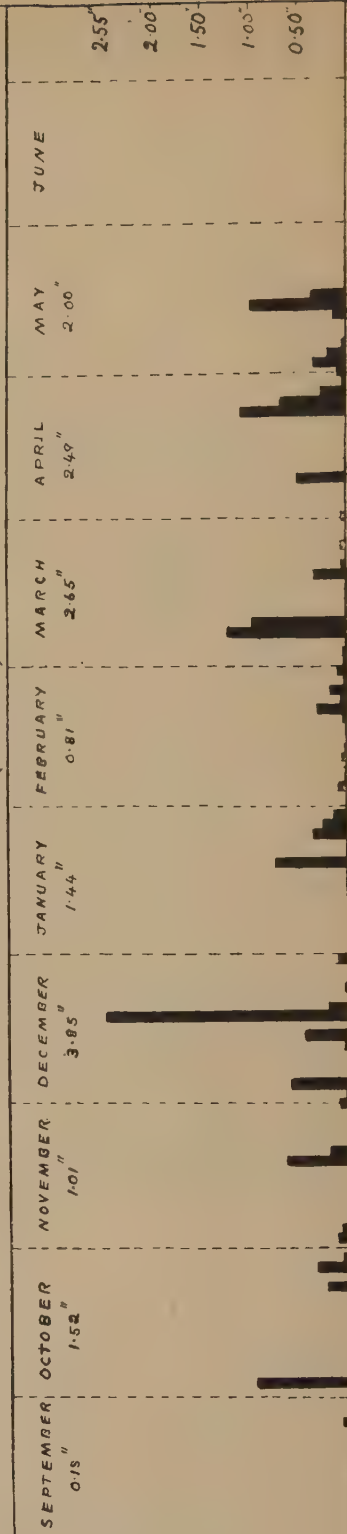
Total for year = 16·55 inches.

RAINFALL (IN TWO DAY TOTALS) SWAZILAND — SEASON 1931-1932

BREMERSDORP



INGWAVUMA (NSOKO)



SOUTHERN RHODESIA

REPORT ON THE WORK OF THE COTTON - BREEDING STATION, GATOOMA, FOR THE SEASON 1931-32.

INTRODUCTORY NOTE BY G. S. CAMERON.

The following Summary of Results from this Station records work performed under the best climatic conditions experienced in the history of the Gatooma Station. These conditions, however, were very different from those experienced in other districts throughout the country, particularly in regard to the end of the season, which, in the Mazoe and Lomagundi areas, was unusually damp and encouraged the spread of internal boll disease.

This state of affairs emphasised the need for obtaining as much information as possible from other districts, a fact which is stressed in the report.

Before embarking on the season's work, it was necessary, owing to the financial position, to consider very carefully how it would be possible to carry on the policy of the Station without too seriously impairing its usefulness. To do this it was necessary to put a great part of the land out of cultivation, but it was decided not to let it revert to "veld" if such a course could be avoided. It is hoped that this difficulty has been overcome by planting dolichos beans and allowing them to shatter, in the hope that a self-sown crop will obviate the expense of ploughing and cultivating a portion of the land until such time as it can be utilized as originally intended.

Thanks to the generosity of the Southern Rhodesian Government, the Station is now provided with adequate laboratory accommodation, and a new electric light and power plant has been installed.

Two new strains U.4/64/V and U.4/64/7/10 will be issued for multiplication in the districts. These have already been tested in various parts of the country and it is anticipated that their behaviour will justify the confidence placed in them.

Meanwhile the U.4/64 strain has proved the most adaptable to varying conditions and it is mostly seed of this strain which will be grown commercially in the approaching season.

COTTON-BREEDING STATION, GATOOMA ; REPORT FOR THE SEASON 1931-32.

SUMMARY OF RESULTS.

The material from which the following report is compiled is based on the work of Messrs. Peat, MacKinstry, and Prentice of the Staff of the Empire Cotton Growing Corporation, assisted by Mr. Rattray, Farm Manager, and Mr. J. Z. Boshoff, Seed Cotton Classifier. Mr. Peat went on leave on the 6th of May 1932.

SEASON.

The season under review is considered to be the best experienced on the Cotton Station at Gatooma since it was established seven years ago. Rains were early and plentiful (*see graph*). Planting started on the 9th and finished on the 30th of November. Weather conditions were ideal. The crop grew well throughout the rainy season, and was not checked by a mild drought in January. The total rainfall for the season was 32.09 inches.

Of the 320 acres under cultivation on the Station, 75 were put down to cotton. Progeny rows, observation plots and multiplication blocks of the different strains, as well as trials, were apportioned so that one half of each was planted one week earlier and on a different type of soil. This duplication gave a wider range of conditions and also a greater margin of safety.

Other crops were maize, which averaged 2,800 lbs. (= 14 bags) per acre over 63 acres : 48 acres of sunn hemp for green manure : and 134 acres of dolichos beans. Of the latter 100 acres were laid down as a perennial crop in order to curtail expenditure.

TRIALS.

All seed used in trials was treated with sulphuric acid and only seed that sank in water was used in planting trial plots. Germination accordingly was excellent and the stand was in the neighbourhood of 85% at time of harvest.

Two six-by-six Latin square, strain trials on two different types of soil had three variables in common. These were strains /64, 64/7, and M.B. (Mixed Bulk U.4) ; six other of the more promising sub-strains of U.4 were included, viz. : 78/3, 106/2, 26/4 in the one trial, and 99/2, 106/3, and 4/4 (ex Barberton 1930) in the other. In both trials treatments were significant. The significant differences between any of the variables are shown in Table I.

TABLE I.
STRAIN TRIALS.LATIN SQUARES 6 × 6 PLOTS: PLOT SIZE $\frac{1}{31.1}$ ACRE.

Type of Soil.	Variables.	/64	64/7	106/2	26/4	M.B.	78/3	Means.	Criterion of Significance P = .05.
BROWN LIGHT LOAM. Planted 19/11/31	Yield on six plots: lb. seed cotton ...	71.85	70.68	62.56	57.76	56.72	56.38	62.65	9.69
	Yield per acre: lb. seed cotton ...	372.18	366.12	324.06	299.20	293.81	292.05	324.57	50.19
	% Yield per acre: lb. seed cotton ...	114.7	112.8	99.8	92.2	90.5	90.0	100.0	15.5
Type of Soil.	Variables.	64/7	4/4	/64	106/3	M.B.	99/2	Means.	Criterion of Significance P = .05.
DARK RED MEDIUM LOAM. Planted 15/11/31	Yield on six plots: lb. seed cotton ...	91.83	91.58	82.01	80.24	77.75	65.03	81.41	16.11
	Yield per acre: lb. seed cotton ...	475.7	474.4	434.8	415.6	402.7	336.8	421.7	83.45
	% Yield per acre: lb. seed cotton ...	112.8	112.5	100.7	98.6	95.5	79.9	100.0	19.8

In two small strain trials where eighteen of the more promising U.4 derivatives were tested against /64, the results were inconclusive. As observation plots for ancillary yield characteristics, however, these small trials proved useful.

In the spacing trial in which the treatments were significant, the order of yields were as under. (See Table II).

TABLE II.
SPACING TRIALS.LATIN SQUARES 6 × 6 PLOTS: PLOT SIZE $\frac{1}{31.1}$ ACRE.

Type of Soil.	Variables.	1 at 6".	1 at 12".	2 at 24".	4 at 24".	6 at 36".	3 at 36".	Means.	Criterion of Significance P = .05.
DARK RED MEDIUM LOAM. Planted 18/11/31.	Yield on six plots: lb. seed cotton ...	119.62	116.18	108.95	101.09	98.16	97.08	106.86	13.93
	Yield per acre: lb. seed cotton ...	619.63	601.81	564.36	523.65	508.47	502.87	553.46	72.14
	% Yield per acre: lb. seed cotton ...	111.9	108.7	102.0	94.6	91.9	90.8	100.0	13.0

The greater yield obtained from one plant per hill at six inches confirms previous results on the Station.

FERTILISER TRIALS AND FERTILISER OBSERVATION BLOCKS.

Results of previous trials have received further confirmation, namely that no benefit is derived in either the first or second season from the application of artificial fertilisers to cotton on the Station.

Yields generally were high in comparison with those of former years. Growth and flowering were excellent, the latter attaining a peak of nearly one flower per linear foot per day, over a period of several weeks on the record lines at 6-inch spacings. The difference between the potential and the actual crops was very marked. The proportion of bolls shed combined with the number which opened badly accounts for this. The problem of low mean boll weight, which seems to be connected with bad opening, is considered important, and requires close investigation.

TABLE III.

ANALYSIS OF CROP—FLOWERING TO BOLLING.

FROM RECORDS ON STRAIN /64, GROWN IN STRAIN TRIALS, ON TWO SOIL TYPES.

<i>Soil Type.</i>	<i>Brown, Light Loam.</i>			<i>Dark, Red, Medium Loam.</i>		
BOLLS SHED	47%	With bollworm punctures	40%	43%	With bollworm punctures	42%
		Without bollworm punctures	60%		Without bollworm punctures	58%
MUMMIFIED BOLLS	17%	With bollworm punctures	50%	16%	With bollworm punctures	48.5%
		Without bollworm punctures	50%		Without bollworm punctures	51.5%
BOLLS MATURED	13.5%	Good bolls	7%	22%	Good bolls	9.5%
		With bollworm punctures	37%		With bollworm punctures	33%
		Without bollworm punctures but badly opened	56%		Without bollworm punctures but badly opened	57.5%
UNACCOUNTED LOSS	22.5%			19%		

OBSERVATION PLOTS AND PROGENY ROWS.

The range of conditions given by the duplication of progeny rows and observation plots on different soils, dates of planting, and spacings was of material benefit in assessing the value of the various strains.

With the favourable season experienced, such qualities as lint length, strength, ginning percentages, seed weights and lint indices were better than in former years. The strains maintained their relative positions for these characters.

U.4 SUB-STRAINS.

With the favourable growing season experienced, and in spite of the severity of bollworm and jassid attacks, yields were high. The better multiplication bulks, *e.g.*, 64/7/10, although widely spaced, yielded at the rate of 750 lbs. seed cotton per acre. Some strains, at a six-inch spacing, in the observation plots, yielded at the rate of over 1,000 lbs. seed cotton per acre.

Derivatives of /64 are again outstanding. One third of the strains now retained and one half of this year's single-plant selections are descendants of /64. /64/V, a strain combining high yielding properties, good lint qualities and greater resistance to jassid than its parent, and 64/7/10, a very prolific, but less jassid-resistant strain, are the two most promising U.4 strains on the Station, and will be issued to growers for bulking in the districts this coming 1932-33 season. 64/7 would have been issued on the strength of its yielding power on the Station, but in the district observation plots, its behaviour did not come up to expectations, probably on account of its greater susceptibility to jassid.

Other important parent stocks selected in 1928 possess a good degree of jassid resistance but, in general, lack some desirable characteristic. Selection is being directed towards yield improvement. 78/3/5, and 34/2/1 are among the more promising strains which are being tested on the Station and in the districts against /64, and its more recent derivatives /64/7/10 and 64/V.

INSECT PESTS.

Bollworms.—Chief among the pests is the American bollworm (*Heliothis obsoleta*) which made its appearance early, at the beginning of January, and gave one main brood which attacked heavily between the middle of February and the end of the first week in March. The intensity of its attack was comparable to that of the previous year (1931), but not nearly so heavy as that of 1930, when the attack was moreover protracted and lasted throughout the greater part of the season.

The incidence of Sudan bollworm (*Diparopsis castanea*) was prolonged and moderately severe. No one main brood was apparent,

but the attack was continuous from the beginning of January until the end of the season.

Spiny bollworm (*Earias spp.*) was not at any time as severe as in the previous year, but was present in small numbers throughout the whole season.

Bollworm Egg Parasites.—*Trichogramma spp.* and a small Chalcid were found both on the Station and in the districts where records were being taken. No breeding up and liberation of parasites were undertaken as facilities were not available, and in any case, it is considered better to wait for results from other centres where more intensive study of this problem is possible.

Stainers.—On the Station stainers appeared early in February in greater numbers than in previous years. In the districts, they seem to have done much greater damage than usual, helped no doubt, by late humid conditions which were favourable to the development of internal boll disease.

Aphis.—This pest was only of minor importance on the Station, but made its usual appearance in varying degrees in the districts. In isolated cases the attack was sufficiently severe to have caused considerable damage.

Jassid.—The jassid attack was definitely the heaviest ever recorded on the Station. Such conditions made it possible to discard or to retain, with greater confidence, selections for jassid resistance. While some of the district crops undoubtedly suffered where jassid was severe, it is felt that had any susceptible varieties been grown they would have been complete failures. Small, nucleus stock plots of Improved Bancroft and Durango, which were kept going on the Station for purposes of comparison, were completely obliterated by jassid.

DISTRICTS.

In the Mazoe and Lomagundi areas, rains were experienced much later in the season than usual. The result was increased humidity and damage by insect pests, particularly stainers, and other plant-sucking insects. This favoured the development of internal boll disease to an unusual degree, with the consequent excessive staining of lint, and it is feared that much damage was done to cotton seed which, even in good years, has its germinating capacity reduced by stainers.

Growth and flowering generally were good, bollworm and jassid attacks were heavy, but nowhere heavier than at Gatooma.

As in 1931 native recorders were again stationed in Mazoe, Lomagundi and near Bulawayo.

In addition to the usual flowering, shedding and bolling records, bollworm counts and collection of bollworm eggs for parasitological observations, a start was made with the help of interested farmers with weather recording on their farms. The native recorders who had to be stationed singly this year instead of in pairs, as formerly, proved efficient. The policy of sub-station recording in other districts has now proved its value over two seasons, and will be continued so long as funds permit.

Small observation plots of the more promising U.4 sub-strains were laid down at various centres, throughout the country. The adaptability of /64 was strikingly confirmed throughout. On the other hand /64/7 proved a relative failure. The latter would have been issued from Gatooma as an improvement on /64 on the strength of its behaviour on the Station over a period of three years. Its failure on outside Stations emphasises the necessity for great caution before issuing new strains until they have been tried at centres other than Gatooma.

SPACING.

The one spacing trial laid down this year, apart from the trials at Gatooma, was on Mr. G. H. Cautherley's farm, Msengi in the Lomagundi district, which showed a six-inch spacing in the row as significantly better for yield than wider spacings.

INCHES

COTTON STATION
CATOOMA 1931-32.

RAINFALL
(2 DAY TOTALS)

30

20

10

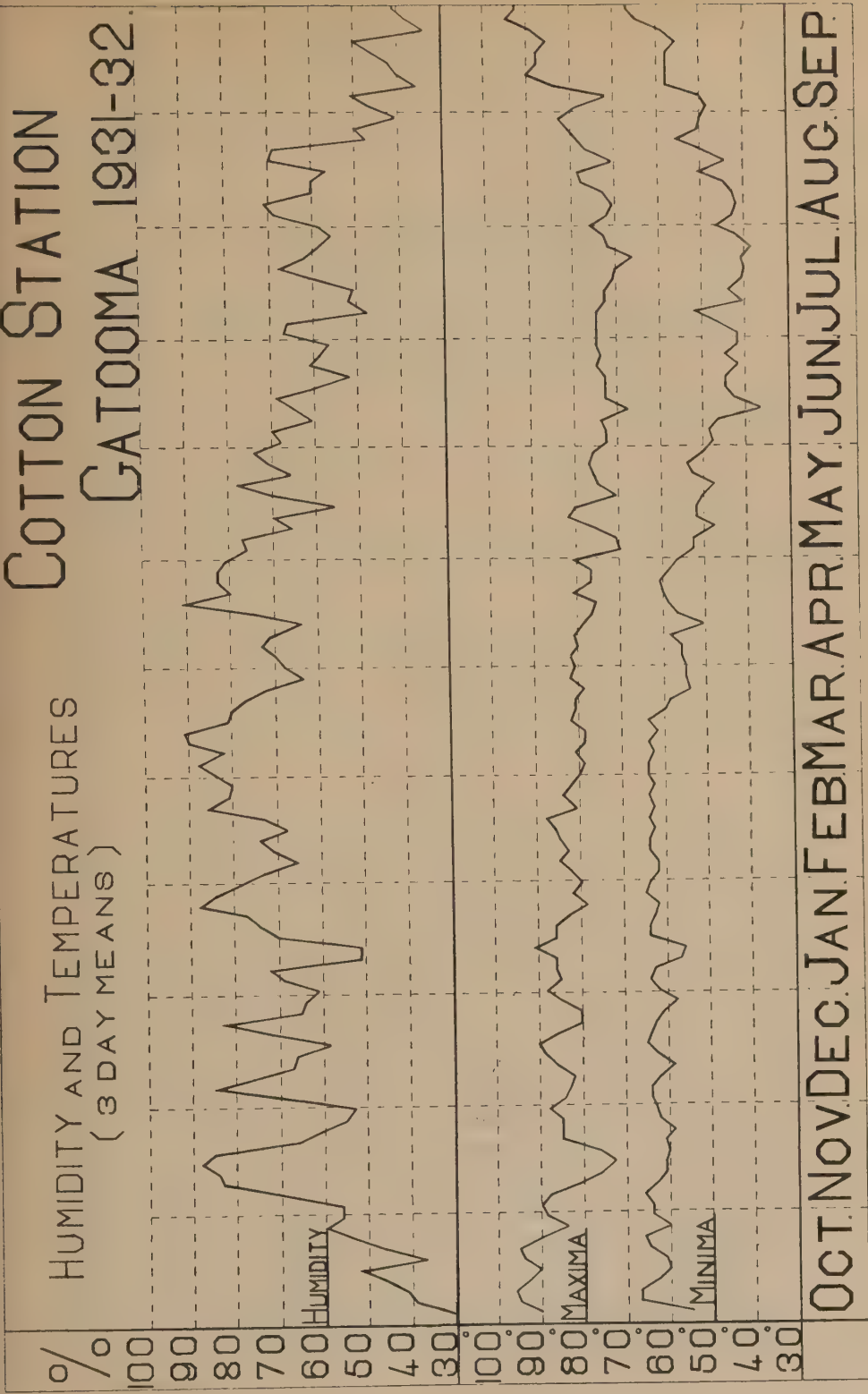
TOTAL RAINFALL = 32.05"

OCT. '64 " NOV. 7-60 DEC. 28 " JAN. 7-28 " FEB. 5-80 MAR. 6-08 " APR. 1-84 "

COTTON STATION

GATOOOMA 1931-32.

HUMIDITY AND TEMPERATURES
(3 DAY MEANS)



NORTHERN RHODESIA.
REPORT OF THE WORK ON COTTON AT THE
RESEARCH STATION, MAZABUKA,
1930-31 and 1931-32.

BY

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 (*Northern Rhodesia Department of Agriculture*).

The present report covers the work for seasons 1931 and 1932. Unfortunately both the writers were on leave during the early part of the latter season and information for that period is not so full as could be desired.

The authors have to thank Mr. R. E. Gregory of the Education Department of the Northern Rhodesian Government, who has done all the lettering on the diagrams.

The assistance of Mr. H. B. Stent in carrying out soil analyses is acknowledged later in the report.

SUMMARY.

The two seasons 1930-31, 1931-32, reviewed in the present report have been very diverse in character. During the former, drought conditions were experienced throughout, while the latter was one of ample rainfall and humid conditions.

As a result of the investigations of the past three years it has become very evident that insect pests, namely, Stainer (*Dysdercus*) and American Bollworm are the present limiting factors in establishing cotton as a commercial crop in North Western Rhodesia. The major portion of the work for the last two seasons has been devoted to these two pests, with particular reference to Stainer, and for the sake of convenience it has been decided to change the form of the report and deal first with the work carried out on them.

Stainer.—The seasonal distribution of the three species of Stainer has been in general similar to that previously recorded. *Dysdercus supersticiosus* has appeared early in both seasons and caused heavy staining in the first pickings. The middle crop has been less damaged, but the later pickings have been heavily stained as a result of the influx and breeding of *D. fasciatus* in very large numbers.

It has been found that the occurrence of these two species is closely correlated with humidity conditions, *D. superstitiosus* predominating when the relative humidity is over 70%. This fact assists in the explanation of the heavier stainer attack in 1931 when drier conditions brought about an earlier influx of *D. fasciatus* into the cotton. In spite of the more prolonged period of high humidity conditions in 1932, the attack of *D. superstitiosus* was not as heavy as in 1931, and it is believed that this is at least partially explained by the existence of large areas of annual host plants which appear to be as attractive as, or more attractive than, cotton and which do not appear in a dry season.

A study has been made of the normal cycle of these two species of stainer between cotton and the wild host plants on which they feed during the inter-crop period.

The attempts to assess the value of seed trapping and hand-picking for the control of cotton Stainer have given very contradictory results and it has been realised that soil conditions, through their reaction on the plants, can influence the degree of staining to a very marked extent. It has been found that the growth and habit of the plant vary considerably with varying soil conditions and that these differences are associated with different degrees of staining. An attempt is being made to ascertain the factors, both chemical and physical, responsible for these variations.

Bollworm.—Only the two species previously recorded have occurred in the last two seasons. A study of the life history of the American bollworm was carried out in 1931 and the period of maximum larval population determined. Records have also been made of the extent and distribution of the damage caused by this pest.

Time of Planting Experiments.—An attempt to escape part of the bollworm attack by altering the time of planting proved unsuccessful owing to the fact that the plantings which escaped bollworm attack produced a very much smaller crop.

A detailed analysis of the crop set by all plantings was made. This showed that, in the early plantings, 84% of the total crop was shed as squares and bolls largely on account of stainer and bollworm. The final crop picked amounted to only 16% and the undamaged crop to rather less than 4% of the total set. In spite of the magnitude of this loss the crop reaped amounted to 600 lbs. per acre. Although in the later plantings there was a reduction in the damage due to bollworm, this was much more than offset by the reduction in the crop set by the plants causing yields to be significantly lower.

Variety Trial.—Trials of variously maturing strains have been carried out during the two years. The comparatively early maturing

strains U.4/2 and U.4/4 proved significantly better than the late maturing strain U.4/6, while U.4/2 was also better than U.4 Bulk. The early maturing strain 955 was the lowest yielder in 1932 and was significantly poorer than U.4/2, U.4/4 and Z.9. The lower yield of 955 was unexpected, as it was thought that on account of its small, open habit and early maturity it might escape severe stainer damage. An examination of the crop produced by this strain showed that it had been heavily stained owing to a large proportion of its crop being set during the period of maximum population of *D. supersticiosus*. The major proportion of the crop carried by the better yielding strains was later and escaped this damage, while they were sufficiently early to avoid very serious loss due to *D. fasciatus*. The late strain U.4/6, on the other hand, was seriously affected by the latter pest.

Seed Distribution.—The experimental plots grown by farmers have not proved very successful. Yields have been low, partly on account of insect pests, but, in addition, the results have, undoubtedly, been affected by late planting and inadequate cultivation. The value of cotton as a rotation crop for maize is, however, still appreciated by the farmer. From information so far obtained from rotational experiments on the Station it has been shown that an increase of from 400 to 600 lbs. per acre may be expected in the yield of maize following cotton. The relative merits of green manure and cotton as rotation crops for maize are at present being studied.

SEASONS.

The two seasons under review differed widely in nature. The year 1931 was one of low rainfall and drought conditions, with poor yields of maize over the greater part of North Western Rhodesia. On the other hand, in 1932 rainfall was high over the whole country, and well distributed, with the exception of one drought period of three weeks to a month in late December and early January. Growing conditions appear to have been better throughout, and high yields of maize were general.

Ploughing rains fell on the Station at approximately the same date in both years, and planting was commenced in the first week of December, which would appear to be the general average date for the country.

Despite the different climatic conditions prevailing, yields of cotton on the Station in the two seasons were very similar in amount, being considerably higher than previously. The quality of the lint in 1931–32 was better than usual.

Jassid appeared in rather larger numbers in 1932 as a result of the more humid conditions, but occasioned little damage to the plants, with the exception of the susceptible variety, Arizona.

INSECT PESTS.

Work under this head during the last two seasons has been confined largely to a study of the species of *Dysdercus* responsible for the transmission of internal bollrots.

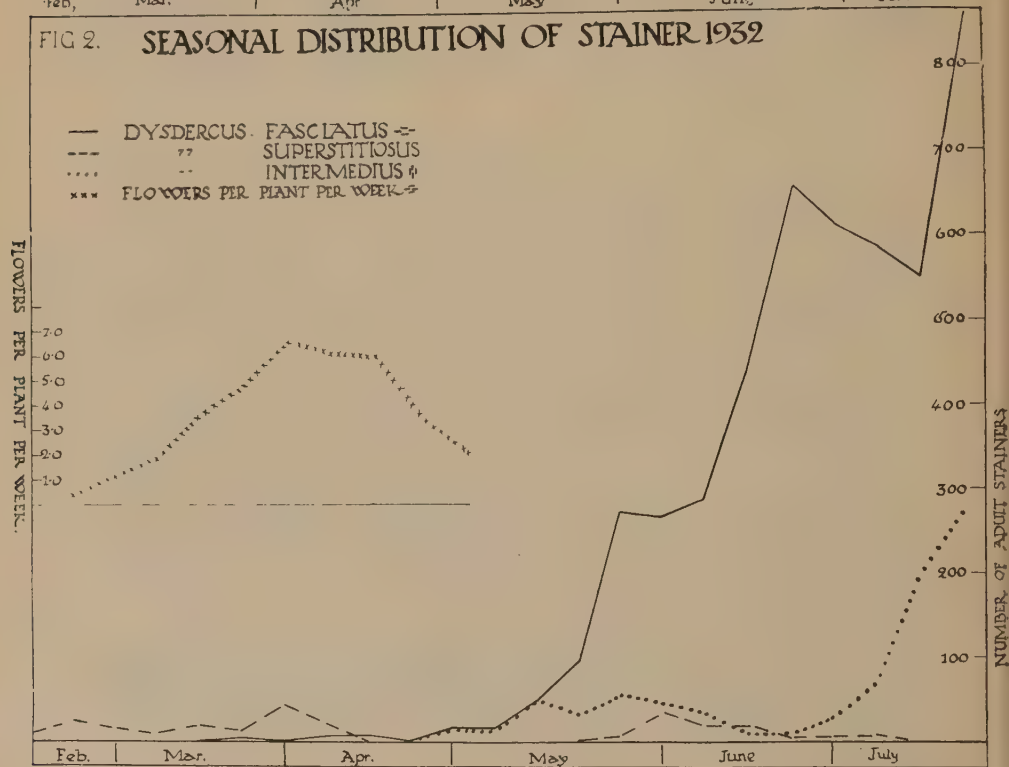
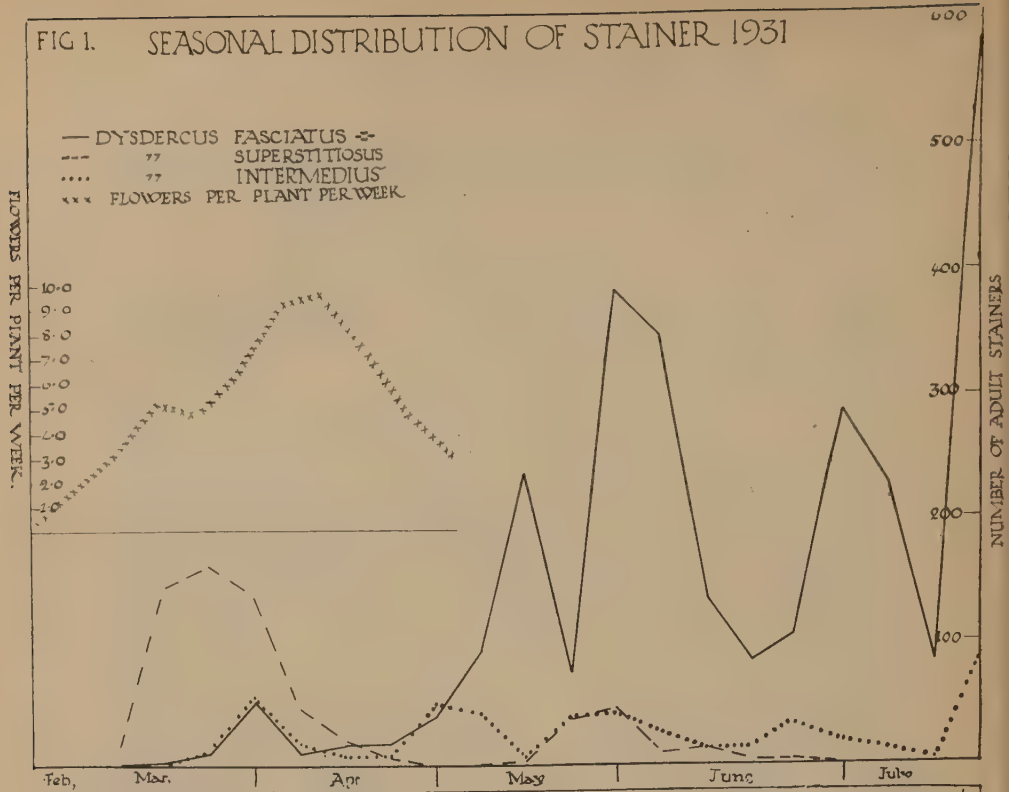
THE VECTORS OF INTERNAL BOLLROT.

Seasonal Distribution of Stainers.—Only the three species already recorded, namely, *Dysdercus supersticiosus*, *Dysdercus fasciatus* and *Dysdercus intermedius* have appeared in the field during the past two seasons. The Pentatomid *Callidea dregei*, Germ. also appeared in considerable numbers, but compared with *Dysdercus* is of minor importance as a carrier of internal bollrot.

In order to obtain curves representative of the seasonal distribution of the four insects, index picking on a bulk of U.4 cotton was carried out in the manner described in "Reports from Experiment Stations, 1929-30." These distribution curves for the seasons 1931 and 1932 are reproduced. (Figs. 1 and 2). In both years *Dysdercus supersticiosus* is plotted on three times the scale of *Dysdercus fasciatus*, while *Dysdercus intermedius* is similarly plotted for 1931, but on the same scale as *D. fasciatus* for 1932.

In each of these years *D. supersticiosus* appears first in the field. It will be seen from the flower count curves plotted on the graphs of seasonal distribution that the first appearance of the species coincides with the commencement of flowering. The influx population rises rapidly to a peak. A second peak followed four and five weeks later in the distributions for 1930 and 1932 respectively. It was proved by breeding out nymphs taken in the field, that this second peak represents maximum emergence of adults of the first filial generation. In the distribution for 1931 the first breeding peak is absent, but it appears that this was due to the late planting of cotton used for the index picking and to conditions of low relative humidity in March. Observations on cotton planted three weeks earlier and used for control experiments, showed a small influx of *D. supersticiosus* reaching its peak during the week ending February 9th and followed by a breeding peak four weeks later.

An attempt was made to correlate the proportion of the two species *D. supersticiosus* and *D. fasciatus* present in the field at different periods throughout the seasons with relative percentage humidity.



This investigation indicated that the former species predominates under conditions exceeding 70% relative humidity, while *D. fasciatus* appears in large numbers in the field only when the relative humidity has fallen below this figure.

In 1930 and 1932 *D. fasciatus* appeared in the field in the latter half of April. The influx peak of these years is followed four or five weeks later by a peak of increase in the population representing partly emergence of adults of the F.1 generation and partly a second influx following the maturation of a generation on the wild host plants. The two subsequent peaks on the distribution graphs represent mainly maximum emergence of the F.2 generation from the first influx, and an F.1 generation from the second influx.

In 1931 the distribution of *D. fasciatus* was complicated by the early appearance of the species in March and the maturation of an F.3 generation from the first influx. This unusually early appearance would appear to be associated with drought conditions which resulted in the relative humidity falling below the 70% level towards the middle of March.

D. intermedius has appeared in relatively small numbers in each year and has not been considered an important factor in the transmission of internal bollrot. The implications of the breeding curves have therefore not been investigated.

Development Period.—During the writer's absence on leave Mr. A. M. Altson carried out some observations on the development of *D. superstitiosus* and *D. fasciatus*. The periods for the two species would appear to be in agreement and to vary with conditions of temperature and humidity.

TABLE I.

Date eggs laid.					Species.	Period of development egg to adult.
Oct. 26	...	...	...	...	<i>D. fasciatus</i> ...	45 days
Oct. 31	...	...	...	...	<i>D. fasciatus</i> ...	43—47 days
Nov. 2	...	...	...	...	<i>D. superstitiosus</i> ...	42—45 days
Nov. 3	...	...	...	...	<i>D. fasciatus</i> ...	40 days
Nov. 17	...	...	...	...	<i>D. fasciatus</i> ...	39—41 days
Dec. 10	...	...	...	...	<i>D. superstitiosus</i> ...	35—48 days
Dec. 17	...	...	...	...	<i>D. superstitiosus</i> ...	42—45 days
Dec. 24	...	...	...	...	<i>D. superstitiosus</i> ...	37—40 days
Feb. 1	...	...	...	...	<i>D. fasciatus</i> ...	25—29 days

Females were observed *in coitu* shortly after the last moult.

The developmental period of the male was found to be two to three days shorter than that of the female, and this fact explains a seasonal rhythm in sex ratio observed during distribution studies.

A predominance of males was noted in the early migrants of *D. fasciatus* and among the first individuals of each generation of both species to become mature. Such predominance of males was not observed in the early migrants of *D. supersticiosus*. Thus it would appear that the migration of *D. fasciatus* to cotton is of a more direct nature than that of *D. supersticiosus*, and follows the maturation of a generation on the wild host plants.

Wild Host Plants.—The problem of ascertaining the wild host plants of *Dysdercus* which are capable of carrying a population over the inter-crop period has been given considerable attention. The observations so far indicate that in the farming area of Northern Rhodesia only two species are of major importance in this respect, namely, the Baobab (*Andansonina digitata*) and a species of *Thespesia*, identified by courtesy of the Forest Office as *T. rogersii*, Moore.

The occurrence of *D. fasciatus* on Baobab has been discussed in a previous report. In the Mazabuka district it is of relatively little importance as a host plant compared with *T. rogersii*. Baobab is of rare occurrence in the neighbourhood and owing to native partiality for the fruit, fallen seed pods are not long allowed to remain on the ground. On the other hand *T. rogersii* appears to be of primary importance around Mazabuka, and this is probably true of the greater part of the farming area. All plants of this species within a considerable distance of the cotton plots have been kept under observation.

In December, under high humidity conditions, *D. supersticiosus* is more abundant on *Thespesia* than *D. fasciatus*. It is still present in January and February, but disappears during the latter month coincident with its appearance on *Hibiscus* and cotton. This species again appears on *Thespesia* in May, but there is no further record of its occurrence until November. Probably the numbers of *D. supersticiosus* are so small during the period of minimum humidity that it has escaped observation.

D. fasciatus breeds on *Thespesia* throughout the year, and it was possible to find nymphs, and adults *in coitu*, at any time except in September when, though nymphs were present, copulation was not observed. During January and February *D. fasciatus* is abundant on *Thespesia*. The population decreases in March and is at its minimum during April and May as a result of migration to the annual hosts. In July population again increases and remains at a high level throughout July and August, coincident with the return migration from the annual hosts.

D. intermedius was also recorded from *Thespesia* during May, July and August.

The normal annual hosts appear to be mainly *Hibiscus* spp. of which ten have been observed locally, and possibly *Abutilon* and *Sida*. Of these *H. cannabinus* is certainly the most abundant and probably the most important, in some years of high rainfall occurring in almost pure stand over large areas. *D. fasciatus* has been recorded only in small numbers on *H. cannabinus* but *D. supersticiosus* appears early on the plants and breeds over a long period. It makes its earliest appearance on the plants in January. From April till June both adults and nymphs could be found on *Hibiscus*, but in July the numbers decreased with the drying up of the plants, and by the end of August no *Dysdercus* could be found on them.

There is some indication from these observations that *Hibiscus* is more attractive to *D. supersticiosus* than cotton. The 1931-32 season was one of heavy rainfall and *H. cannabinus* grew well in close proximity to the cotton lands. *D. supersticiosus* appeared in much smaller numbers than usual on cotton, but the species was very common on closely adjacent *Hibiscus*. Chiaromonte has suggested a similar preference in the case of *D. cardinalis* in Italian Somaliland. (R.A.E. Ser. A. Part 7—July, 1932).

Distribution and extent of damage caused by Dysdercus spp.—A preliminary attempt to ascertain the seasonal distribution and extent of the damage caused by *Dysdercus* was outlined in the report for the season 1929-30.

During the two succeeding years different methods were employed. In 1930-31 tagging of all newly formed squares was carried out on plants included in a time-of-planting experiment with U.4 cotton. A randomised block layout was used, there being eight plantings at weekly intervals, each replicated eight times. Five plants in each of the 64 plots were so treated, giving 40 plants for each planting. All shed squares and bolls were collected daily and examined in the laboratory. Bolls were picked as they opened and were also examined for degree of staining. In this examination lint damaged by stainer was divided into two classes :—saleable and unsaleable. The former class included slightly stained lint, the strength of which had been affected only to a slight degree, while the latter consisted of completely rotted or badly discoloured weak lint. Comparable figures for the season 1931-32 were obtained by weekly pickings of all open bolls from a similar time-of-planting experiment, using 160 plants for each planting. The distribution of staining for three times of planting in each of the two seasons are shown in Figs. 3 and 4. There is a

FIG 3. SEASONAL DISTRIBUTION OF STAINING OF
 - MATURE CROP 1931 -
 PERCENTAGE LOCKS STAINED

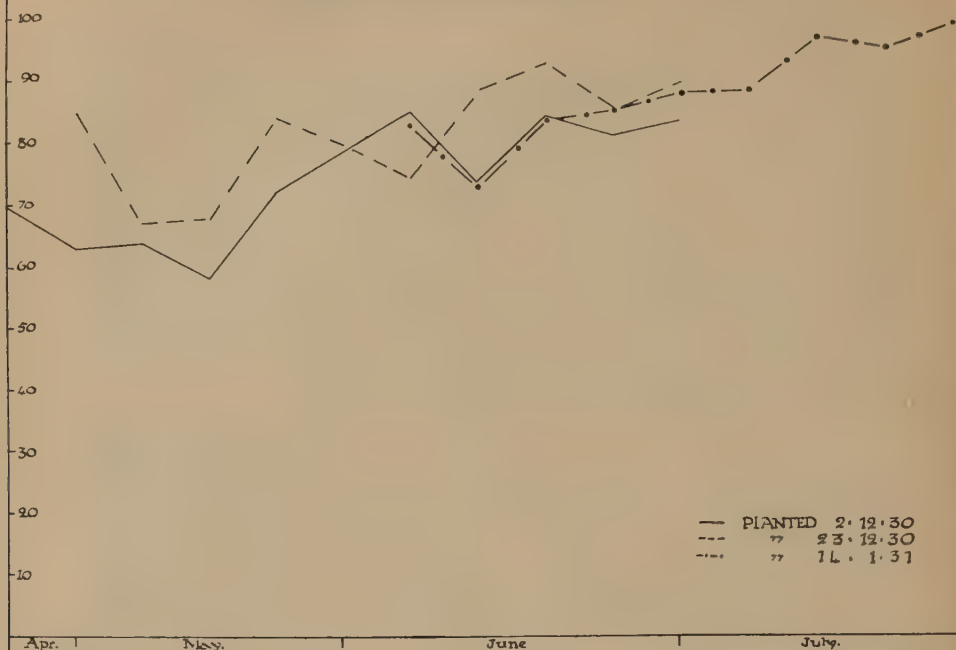
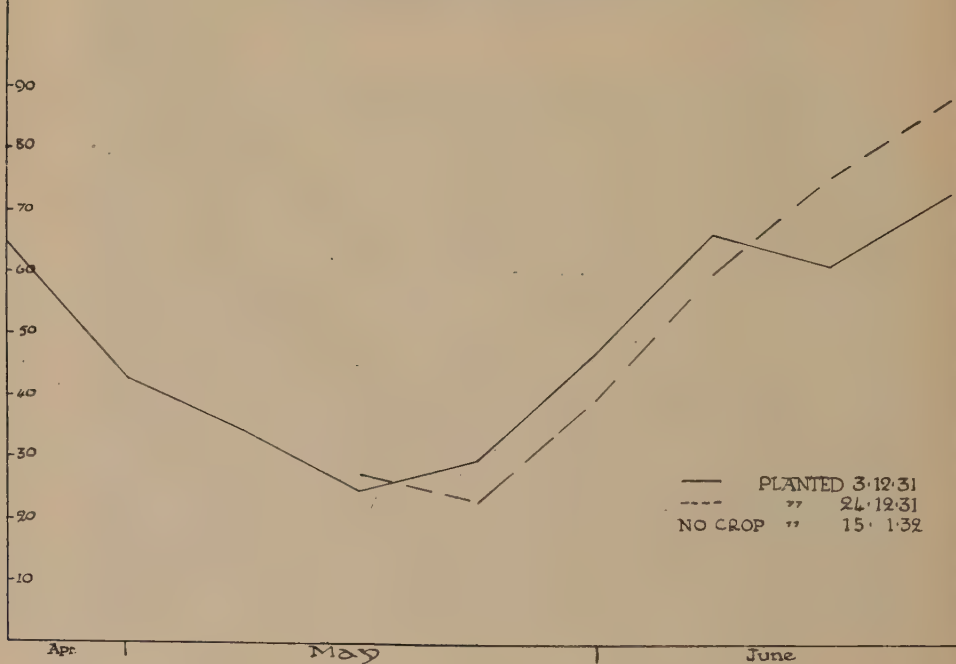


FIG 4. SEASONAL DISTRIBUTION OF STAINING OF
 - MATURE CROP 1932 -
 PERCENTAGE LOCKS STAINED



considerable difference in the distribution of staining during the two seasons. These variations agree closely with the observed difference in the distribution of *Dysdercus* spp.

In both years the initial degree of staining is high and similar in amount, and may be assumed to have resulted from the first influx of *D. supersticiosus*. The marked decrease in the staining of the intermediate crop of 1931-32 coincides with the period of minimum *Dysdercus* population and the rise in staining of the late crop with increasing numbers of *D. fasciatus*. The decrease in staining of the intermediate crop for 1931 is not so marked and this again is in agreement with a shorter period of minimum population occasioned by the early appearance of *D. fasciatus*. The rapid fall of the early staining in 1932 may be associated with a movement of *D. supersticiosus* from cotton to *Hibiscus cannabinus* which as already stated, occurred in almost pure stand over large areas during this season.

Shedding.—It has already been shown by various workers that stainer punctures may cause the shedding of young bolls. An attempt was made in 1931 to estimate the loss of crop which might be attributed to this cause. The bolls shed daily from the ticketing experiment were divided into four categories as follows :—

(a) Apparently uninjured bolls ; (b) Bolls damaged by Bollworm ; (c) Bolls showing proliferations due to insect puncture and presumably shed for this reason ; (d) Bolls of which the cause of shedding could not be determined. Bolls in this class were so badly rotted or mummified that the presence or absence of insect punctures could not be established.

The amount of shedding attributed to *Dysdercus*, expressed as a percentage of the total shedding is shown in Fig. 5. Figures for three dates of planting are plotted at weekly intervals.

The distribution of the damage so expressed is also in agreement with the fluctuation in population of *Dysdercus* during the period.

Loss due to undetermined causes represents a considerable percentage of the total shedding and is plotted in Fig. 6. It is probable that a certain amount of this loss is attributable to *Dysdercus*, but the distribution is not in close accordance with shedding definitely due to *Dysdercus* and additional factors are probably involved.

Control of Cotton Stainer.—During the past three years endeavours have been made to assess the value of seed trapping, handpicking, and a combination of the two for the control of *Dysdercus*. The method has already been described (see "Reports from Experiment Stations, 1929-30") and preliminary conclusions stated.

FIG 5. PERCENTAGE OF TOTAL SHEDDING
 = DUE TO STAINER =
 WEEKLY INTERVALS

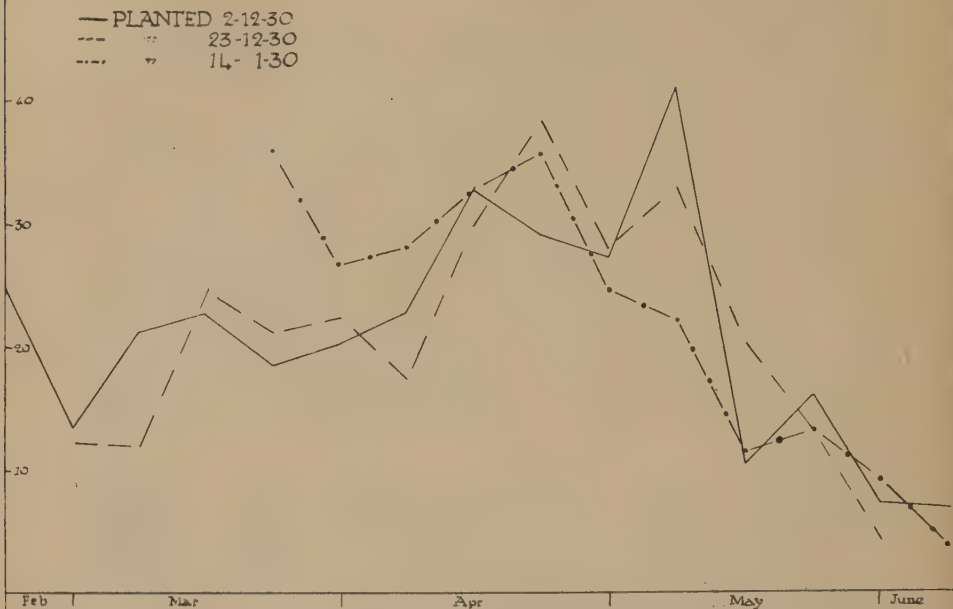
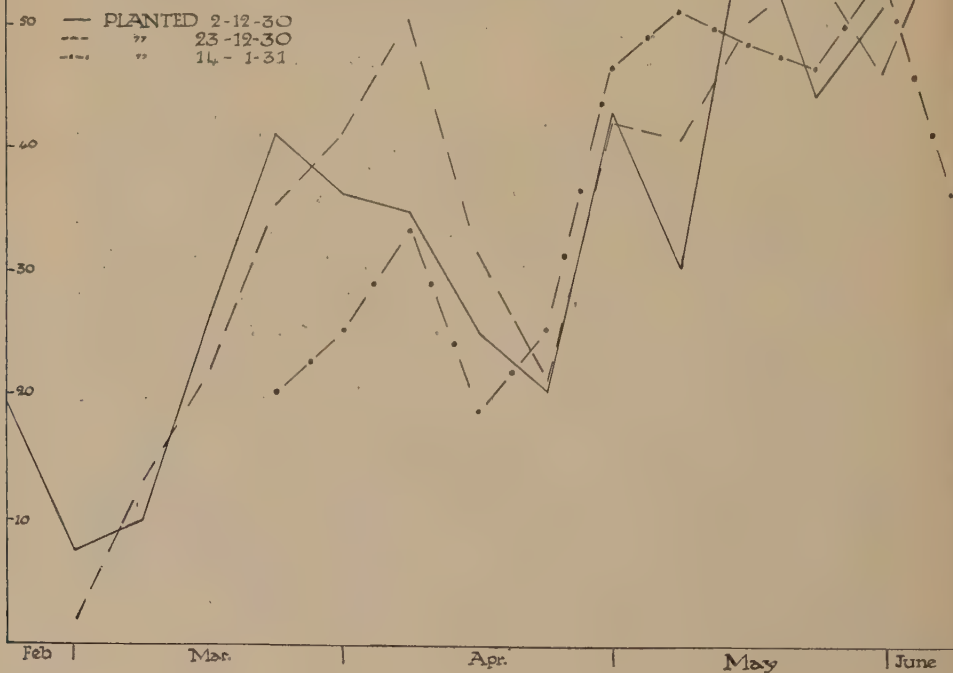


FIG 6. PERCENTAGE OF TOTAL SHEDDING
 DUE TO INDETERMINED CAUSES
 = WEEKLY INTERVALS =



Figures of staining for all three seasons are given in Table II together with the numbers of adults and nymphs of *Dysdercus* removed from one acre throughout the season, except in the case of 1931-32 when $\frac{3}{4}$ acre plots were used. Traps were laid at the rate of 80 per acre throughout. The results are of a somewhat contradictory nature. In a number of cases it appeared that a certain measure of control had been effected, but an indication that factors were involved which had not been taken into account was obtained in the 1930-31 season. In that season, although 170,000 adults and nymphs were removed from one acre by handpicking, the percentage of staining was approximately 10% higher than in the uncontrolled plot. In 1931-32 a similar failure to reduce the percentage of staining below that of the uncontrolled plot was recorded.

TABLE II.
1929-30.

Method of Control.	No. of <i>Dysdercus</i> removed from one acre.		% of Locks stained but saleable.	% of Locks stained but unsaleable.	% Total Locks stained.
	Adults	Nymphs			
1 Seed traps only ...	14,609	14,061	—	—	36.1 $\pm$ 1.6
2 Handpicking ...	30,180	31,657	—	—	35.7 $\pm$ 1.1
3 None ...	—	—	—	—	53.6 $\pm$ 1.5

1930-31.

1 Seed traps only ...	16,665	33,923	20.0 $\pm$ 1.0	18.2 $\pm$ 1.4	38.8 $\pm$ 1.6
2 Seed traps and Handpicking ...	24,543	49,568	15.8 $\pm$ 1.2	15.9 $\pm$ 1.2	32.3 $\pm$ 1.3
3 None ...	—	—	26.6 $\pm$ 1.2	35.2 $\pm$ 1.9	62.4 $\pm$ 1.6
4 Handpicking ...	53,062	124,582	18.2 $\pm$ 1.5	37.7 $\pm$ 2.0	55.9 $\pm$ 2.0
5 None ...	—	—	20.4 $\pm$ 1.5	26.1 $\pm$ 1.4	46.5 $\pm$ 1.7

1931-32.

1 Seed traps only ...	3,833	8,014	21.5 $\pm$ 1.6	34.2 $\pm$ 0.9	55.7 $\pm$ 1.4
2 Seed traps and Handpicking ...	44,045	64,490	17.7 $\pm$ 1.1	28.3 $\pm$ 1.6	45.7 $\pm$ 1.6
3 Seed traps and Handpicking ...	40,416	33,004	15.1 $\pm$ 1.6	16.0 $\pm$ 0.8	31.1 $\pm$ 1.6
4 None ...	—	—	16.9 $\pm$ 1.6	19.4 $\pm$ 0.9	35.4 $\pm$ 1.9

It was pointed out in the Summary of work for 1930-31 that soil conditions affected the growth of the plant and the degree of staining. One field was found to be particularly suitable for observing these effects as it contained two types of soil readily distinguishable to the

eye both from the point of view of plant growth and from that of physical appearance. The distribution of these two soil-types was mapped. In the present season a time-of-planting experiment with U.4 cotton was arranged so as to lie across the soil differences. It was found that growth conditions similar to those observed in 1930-31 occurred on the same soil patches. The light soil again produced a small open plant carrying a relatively clean crop, while the dark soil produced a large bushy plant carrying a badly stained crop. It was thought that this difference in staining might be due to differences in the amount of shade provided by the plants. An examination of the soil profiles of each of the two distinct types and chemical analysis of samples taken from all plots of the first two plantings was undertaken by Mr. H. B. Stent, Soil Chemist to the Government, to whom the special thanks of the Corporation are due. (See Appendix). The crop from 20 plants in each of the eight plots of the first three plantings was examined in the usual way for degree of staining. In addition, height measurements of these plants were taken when picking had been completed. It is clear that this method is not very satisfactory, but it was the only one possible owing to the writers' absence on leave during the growing season. The figures obtained are given in Table 3. In this table plots known to have been definitely on the light soil are marked with an asterisk while plots on soil probably of an intermediate composition are marked with a dagger. The unmarked plots in the table were definitely on soil of the heavier type.

The difference in growth of the three groups of plants is clearly shown, and a very much larger crop was set by the plants growing on the heavier soil. This is demonstrated by the Flower Counts given in Fig. 7 which are compiled from plots on each type of soil, 20 plants per plot being used.

The seasonal distribution of staining on the extreme types of soil is shown in Fig. 8. It will be seen that staining is consistently heavier on plants growing on the dark soil, and that the two distributions are similar in character. In spite of the much heavier crop set on the dark soil, the final crop of clean cotton picked from the experiment showed little difference over the different plots. (See Time of Planting Experiment). It would therefore appear that the increased stainer damage had compensated for the difference in the potential crop set. This is not in agreement with the preliminary results recorded in 1931, when a much heavier yield was obtained from the plants on the lighter type of soil (see "Reports from Experiment Stations, 1930-31"). The difference may be explained by the heavier stainer infestation in the 1931 season.

FIG 7 EFFECT OF SOIL TYPE ON FLOWERING

FLOWERS PER PLANT -
PER DAY-3 DAY MEANS

— DARK SOIL PLANTED 3-12-31
--- LIGHT SOIL PLANTED 3-12-31

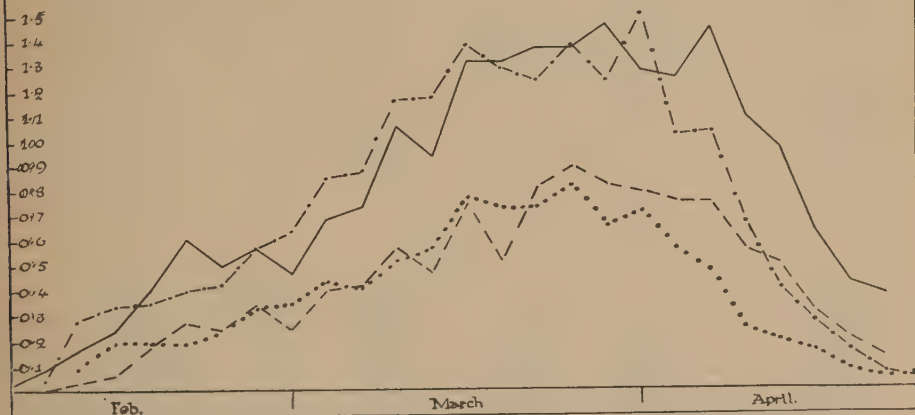


FIG 8 EFFECT OF SOIL TYPE ON DEGREE OF STAINING.
PERCENTAGE OF MATURE CROP STAINED AT WEEKLY INTERVALS

— DARK SOIL PLANTED 3-12-31
--- LIGHT SOIL PLANTED 3-12-31

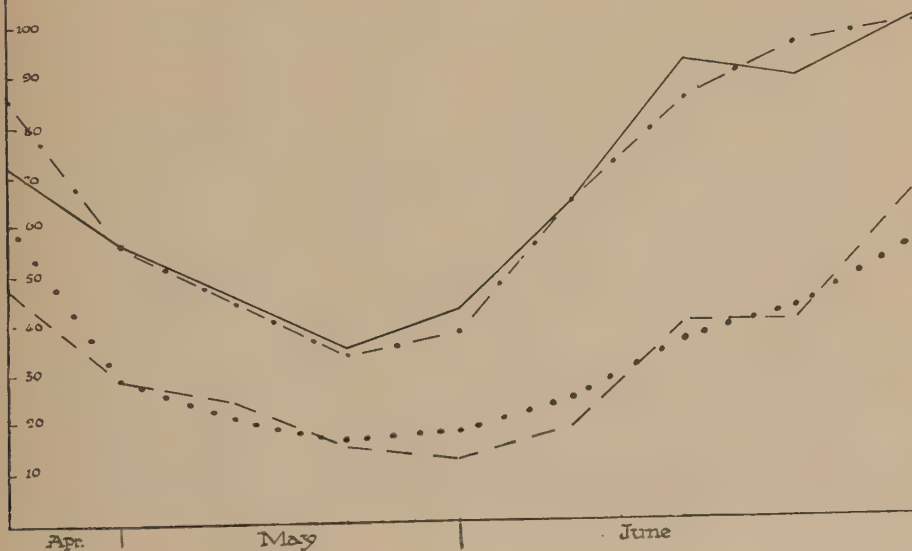


TABLE III.

<i>Plot.</i>	<i>Total No. Locks examined per plot.</i>	<i>% Locks stained but saleable.</i>	<i>% Locks stained and unsaleable.</i>	<i>% Total Locks stained.</i>	<i>Mean height of plants.</i>
*A.1	887	14.5	13.6	28.2	82.9 ± 3.8
*A.2	1,077	11.0	10.5	21.5	79.5 ± 3.5
*A.3	1,010	7.3	13.4	20.7	85.5 ± 2.9
†A.4	1,347	13.9	25.0	38.9	93.4 ± 3.8
†A.5	1,219	10.7	20.2	30.9	96.2 ± 4.3
A.6	1,438	13.8	37.9	51.7	107.5 ± 4.7
A.7	1,454	15.1	30.5	45.5	110.1 ± 3.4
A.8	1,700	20.0	34.4	54.4	113.0 ± 3.6
*B.1	1,014	17.0	12.4	29.4	88.4 ± 4.8
*B.2	805	17.1	10.4	27.6	76.2 ± 3.1
*B.3	733	13.6	13.0	26.6	79.5 ± 4.2
*B.4	815	14.0	11.6	25.6	77.5 ± 3.9
B.5	1,577	18.3	21.8	40.1	103.6 ± 3.9
†B.6	1,187	12.6	13.8	26.4	96.0 ± 3.4
B.7	1,629	18.0	30.7	48.7	117.1 ± 2.1
B.8	1,595	19.7	45.0	64.7	109.9 ± 4.2
*C.1	499	9.6	19.6	29.2	52.1 ± 3.4
*C.2	1,114	10.3	14.4	24.8	95.8 ± 3.6
*C.3	891	12.0	16.4	28.4	82.0 ± 3.3
†C.4	868	10.4	23.3	33.6	85.9 ± 3.1
C.5	1,041	13.8	29.6	43.4	103.3 ± 4.1
C.6	1,123	15.0	37.9	52.9	107.0 ± 2.5
C.7	1,047	11.2	44.9	56.1	111.8 ± 3.8
C.8	1,322	15.9	58.3	74.2	115.2 ± 4.5
	<i>Total No. Locks examined.</i>		MEANS.		
Light soil ...	8,845	12.6	13.5	26.2	79.9
Intermediate soil ...	4,631	11.9	20.6	32.5	92.8
Dark soil ...	13,926	16.1	37.1	53.2	109.8

This effect of soil conditions on the plant and indirectly on the degree of staining must be taken into account when considering the validity of the method used in attempting to assess the fundamental value of seed trapping and handpicking. The areas used for testing these methods of control had of necessity to be separated from each other by a considerable area of maize, this giving full scope for the operation of soil factors. It was noted that in 1930-31 the plants on the area used for handpicking were considerably better developed than those in the uncontrolled plot, while similarly in the present season, the uncontrolled plot made poorer growth than the trapped and handpicked areas.

The extreme differences in staining on the time-of-planting experiment was 53.5%, while the mean difference and the minimum amounted to 27% and 10.7% respectively. It seems reasonable to suppose when such variations can take place over very small areas

that the method which has been employed to assess the value of control measures is entirely inadequate. Thus the apparently satisfactory estimates of the reduction of staining caused by seed trapping and handpicking in 1930 (see Table 2) would appear to be due entirely to coincidence of soil conditions.

So far no method within the limits of reasonable cost has been devised for the estimation of the value of any control measure. Ordinary methods of plot experimentation are inapplicable owing to the influx of stainers from controlled to uncontrolled plots.

In view of the fact that the removal of large numbers of stainers did not reduce staining below that of the control plots, it would appear probable that soil differences are capable of influencing the degree of staining to an extent greater than can be attained by artificial means.

BOLLWORM.

Only two species, *Earias insulana* and *Chloridea obsoleta* have been observed in the past two seasons.

A study of the course of development of *Chloridea obsoleta* was carried out in large field cages in 1930-31. Larvæ of the first generation appeared in the field about the middle of February, and commenced to pupate early in March, the pupal period averaging 14 days. Moths of the first generation bred on cotton emerged from March 19th till 2nd April, maximum emergence being on the 25th and 26th March.

Young larvæ of the second generation hatched out about the end of March, twelve days after emergence of the first moth, and pupated from 3rd to 14th May. The pupal period of this generation averaged 16 days. Moths of the second generation bred on cotton first emerged on May 20th. The two generations on cotton overlap to a considerable extent.

The periods of maximum larval population do not appear to have varied greatly during the past three years, although there has been considerable variation in the actual numbers present in the field as reflected by the varying extent of the damage caused by bollworm.

A large amount of shedding of both squares and bolls was caused in 1929-30 when the population of both generations was very large. The shedding of squares and bolls in 1930-31 is given in Figs. 9 and 10, unfortunately it was impossible to obtain figures for shedding in 1932. From these figures it may be seen that the major portion of the shedding during the season 1931 was caused by the first generation of *Chloridea* larvæ, as opposed to the previous season when the greatest amount of shedding could be attributed to the second generation.

FIG 9

SQUARE SHEDDING DUE TO BOLLWORM

+1931+

SQUARES PER PLANT
PER WEEK — — —
— PLANTED 2-12-30
--- " 23-12-30
- - - " 11-1-31

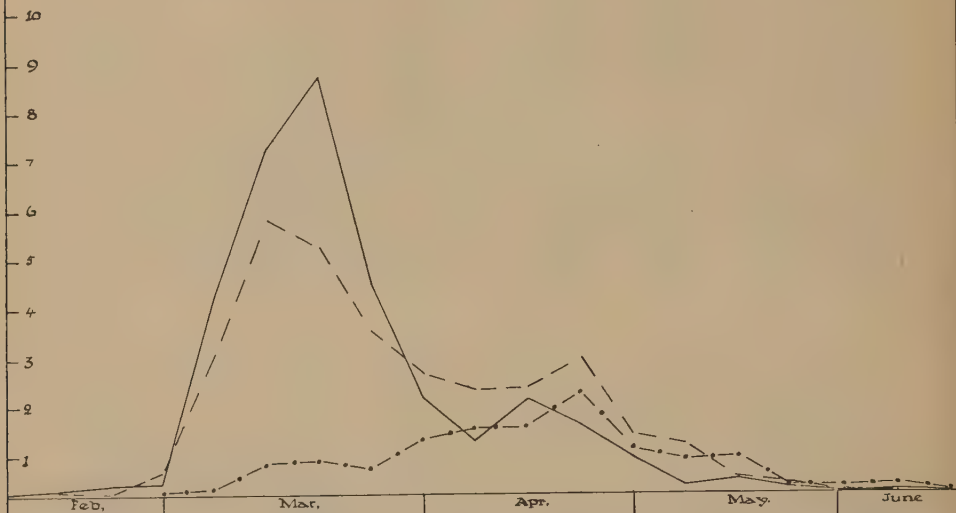
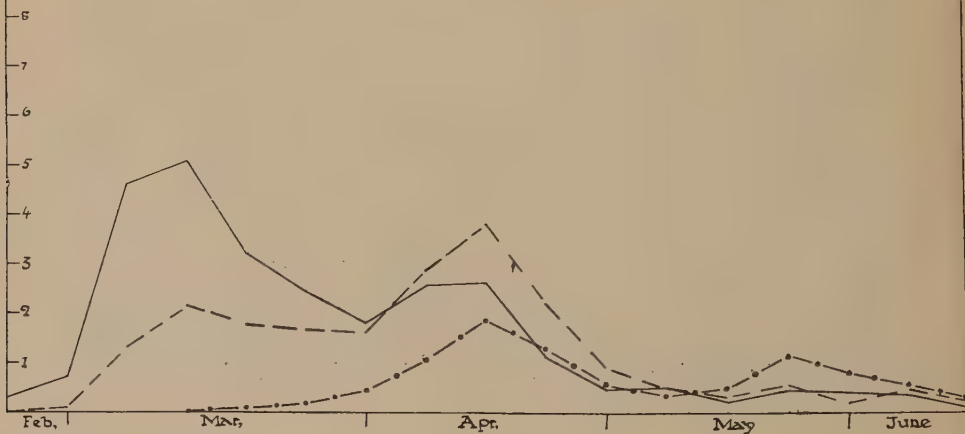


FIG 10 BOLL SHEDDING DUE TO BOLLWORM 1931

BOLLS PER PLANT
PER WEEK — — —
— PLANTED 2-12-31
--- " 23-12-31
- - - " 11-1-31



In 1932 the bollworm attack was very light. Records of distribution obtained by collecting bollworms at weekly intervals from approximately 900 plants showed that the numbers in each generation were relatively small, though the second was larger than the first. The variation in bollworm numbers is again reflected in the extent of damage among bolls which come to maturity. Table 4 shows the percentage of locks damaged by bollworms in the crop picked, and was obtained by the examination of all bolls from 30 samples of ten plants taken at random from an acre of U.4 cotton, three to five separate acres being sampled in this way each year.

TABLE IV.

Plot No.	1929-30.		1930-31.		1931-32.	
	% Locks damaged by bollworm.		% Locks damaged by bollworm.		% Locks damaged by bollworm.	
1	16.1 $\pm$ 1.1		8.1 $\pm$ 0.4		7.9 $\pm$ 0.5	
2	14.5 $\pm$ 1.0		9.8 $\pm$ 0.7		8.1 $\pm$ 0.4	
3	17.0 $\pm$ 1.3		5.3 $\pm$ 0.3		8.7 $\pm$ 0.5	
4	—		9.2 $\pm$ 0.8		7.8 $\pm$ 0.4	
5	—		10.8 $\pm$ 1.0		—	
Means	15.9		8.6		8.1	

It was shown in 1930 that the damage due to bollworm was considerably less in the later crop constituting the 2nd picking, and it was thought that a late planted crop or later maturing strain might escape bollworm damage to some extent. The method has not been successful for reasons which are considered under the following headings.

Time-of-planting Experiments.—As a result of the low percentage of damage caused by *Chloridea* to the second pickings in 1930, and the good performance of the late maturing strain U.4/6, it was thought that later planting might assist in the control of bollworm. It was primarily for this purpose that the time-of-planting experiments already described, were carried out in each of the years under review.

Boll Maturation Period.—This was assessed for bolls maturing during April, May, and June in 1931. The dates on which tagged squares flowered were noted, and the average period from tagging to flowering obtained. From 3,750 observations this period was found to be 25 days.

Some difficulty was encountered in obtaining the period from flower to boll as the number of bolls which attained maturity undamaged was too small to give a reliable figure. The periods for healthy and for slightly stained bolls were examined separately and as little or no difference was observed the figures were taken together. The final results are given in Table 5.

TABLE V.

Period of Tagging.	No. of observations.	Period from flower to boll.		Month boll matured.
		Range in days.	Mean period.	
27.1—12.2 ...	141	75—91	58.4 ± 0.7	April
4.2—11.3 ...	377	76—101	62.1 ± 0.8	May
2.3—30.3 ...	65	75—108	65.2 ± 1.3	June

Yields.—In both years the stand obtained was very uneven due principally to violent rain storms and erosion. As a result, the yield figures for 1931 are based on 50 plants per plot, while those for 1932 are taken from 100 plants per plot. The yield figures of the experiments for the past two years are given in Tables 6 and 7.

The yield per acre were figures calculated on the basis of a perfect stand and are given as a matter of interest only.

TABLE VI.

Date of planting.		Total Yields 8 plots (lbs. seed cotton).	Mean Yield per plot.	Yield per acre (lbs. seed cotton).
2.12.30	...	28.9	3.6	606
9.12.30	...	26.6	3.3	558
16.12.30	...	15.7	2.0	330
23.12.30	...	14.5	1.8	304
30.12.30	...	9.0	1.1	180
6.1.31	...	5.9	0.7	124
13.1.31	...	4.3	0.5	90
20.1.31	...	4.7	0.6	98

Standard Error of difference between two plantings = 0.31.

Difference required for significance ($P. = 0.05$) = 0.6.

In the case of the 1931–32 experiment the yield figures for each plot are given. The soil differences in this experiment and their reaction on the plants have already been discussed. Plots on the light soil are marked with an asterisk, while those on an intermediate type are marked with a dagger.

TABLE VII.

Date of planting.	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Mean Yield.	Yield per acre lbs. seed cotton.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
3.12.31	*7.8	*7.9	*9.9	†10.8	†7.8	9.5	9.8	9.4	9.1	765
10.12.31	*6.9	*6.7	*6.8	*8.6	6.4	†6.1	9.0	10.4	7.6	638
17.12.31	*8.9	*7.4	*8.1	†4.5	4.5	6.6	7.5	4.5	6.5	546
24.12.31	6.0	6.5	4.8	5.6	3.9	5.8	6.1	4.5	5.4	462
31.12.31	3.7	3.3	3.5	1.7	2.9	3.3	3.1	0.8	2.8	233
7.1.32										
14.1.32					No	Crop				
21.1.32										

Standard Error of difference between two plantings = 0.65.

Difference required for significance ($P. = 0.05$) = 1.3.

It will be seen that in spite of the larger crop set by the plants on the dark soil (see Fig. 7) the differences in staining compensated to a large extent for this in the earlier plantings, and this confirms the result obtained from examination of the crop of individual plants (see Table 3). In the later plantings the yield from the dark type of soil was considerably less than from that of the lighter type. This last result is presumably due to the fact that the later plantings matured their crop during the heavy late attack of *Dysdercus*. The results of these two experiments show that early planted cotton is definitely superior in yield to the later plantings.

An analysis of the crop set by each planting was obtained from the square tagging carried out in 1930-31 and showed very clearly the reasons for the superiority of the early planted crop in that season. The figures for three plantings are given in Table 8.

From inspection of the table it may be seen that, as expected, the loss from bollworm is less in the later plantings than in the early. This decrease is, however, more than balanced by the fact that the later plantings set a very much smaller crop. Further, the later plantings suffered more loss from stainer damage. The figure representing the amount of this damage is probably rather higher than it would be were it not that the later plantings experienced a higher *Dysdercus* population owing to influx from the early planted plots.

From the data which have been obtained on the distribution of stainer damage during the last two seasons it would seem that a medium planting or a somewhat later maturing strain than U.4 Bulk would evade the first heavy attack of *D. supersticiosus*.

Such a strain or planting would however still be open to serious damage by bollworm and also to the possibility of a delayed appearance of *D. supersticiosus* such as has been observed. Further, the effect of climate on the setting of crop has still to be included. As is shown in the flower count curves and bolling curves for the two seasons (Figs. 11, 12, 13, 14) the decrease in crop set is very marked in the later plantings, and for this reason alone late planting is to be avoided.

Variety Trial.—In order to supplement the information obtained from the time-of-planting experiments, trials of differently maturing strains have been carried out in the last two seasons. The layout was the same for each season, namely a randomised block containing 6 strains replicated 8 times. The strains used were:—In 1930-31, U.4 Bulk, U.4/2, U.4/4, U.4/4/2, U.4/6 and U.4/M.189, while in 1931-32 the above were again used with the exception of U.4/4/2 and U.4/M.189 for which two Barberton strains of U.4, namely Z.9 and 955 were substituted.

TABLE VIII.
ANALYSIS OF CROP SET BY THREE TIMES-OF-PLANTING—1930-31.

Date of Planting	Total squares set per plant.	Squares shed, as squares per plant.				Bolls shed, as bolls per plant.				Mature bolls picked, in bolls per plant.					
		Total squares shed.	Due to boll-worm.	Due to phys. causes.	Due to un-known causes.	Total bolls shed.	Due to boll-worm.	Due to phys. causes.	Due to stainer.	Due to un-known causes.	Total bolls picked.	Damaged by boll-worm.	Damaged by stainer but saleable.	Damaged by stainer but unsaleable.	Healthy.
2.12.30	123.21	40.34	31.73	5.08	3.53	62.73	26.8	4.98	13.72	17.23	20.14	1.39	4.09	10.02	4.64
		32.8%	25.7%	4.1%	2.8%	50.7%	21.7%	4.0%	11.1%	13.9%	16.5%	1.1%	3.3%	8.1%	3.7%
23.12.30	104.74	34.34	29.45	2.76	2.13	57.30	20.35	3.45	13.52	19.98	13.10	1.07	1.89	8.47	1.67
		32.8%	28.1%	2.6%	2.0%	54.7%	19.4%	3.3%	12.9%	19.1%	12.5%	1.0%	1.8%	8.1%	1.6%
14.1.31	57.69	15.27	10.53	1.89	2.85	30.09	8.87	2.84	6.78	11.6	12.33	0.48	2.21	8.81	0.83
		26.5%	18.2%	3.3%	4.9%	52.1%	15.3%	4.9%	11.7%	20.1%	21.4%	0.8%	3.8%	15.3%	1.4%

Abbreviations : Phys. = Physiological i.e., Shed squares and bolls apparently undamaged.

FIG 11 TIME OF PLANTING EXPERIMENT + 1930-31+

FLOWERS PER PLANT
PER DAY - 3 DAY MEANS
— PLANTED 2-12-30
--- " 23-12-30
- - - " 14-1-31

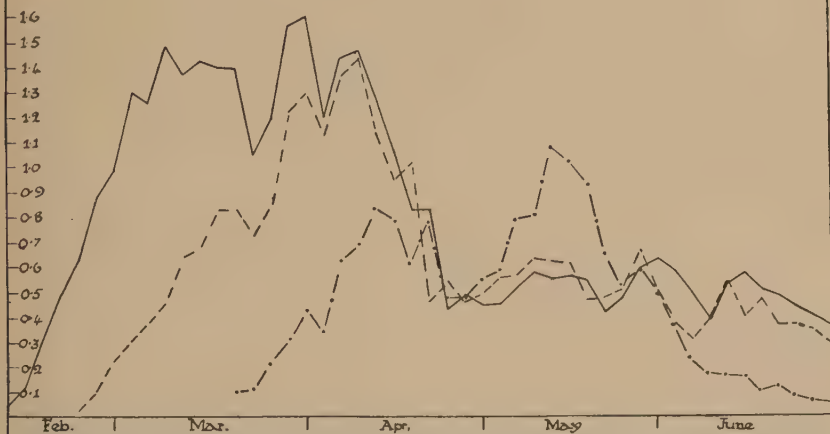


FIG 12

BOLLS PER PLANT
PER WEEK
— PLANTED 2-12-30
--- " 23-12-30
- - - " 14-1-31

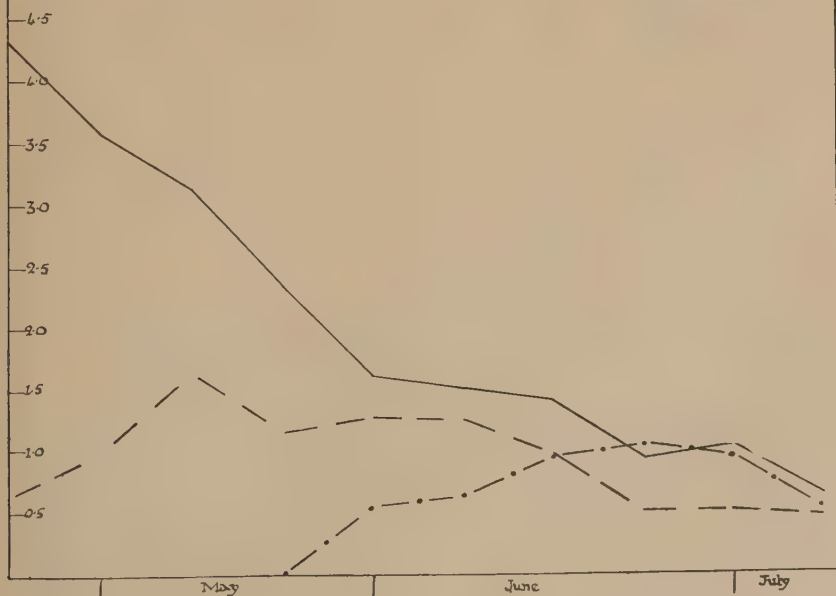


FIG 13 TIME OF PLANTING EXPERIMENT -1931-32-

FLOWERS PER PLANT
PER DAY-3 DAY MEANS

— PLANTED 3-12-31
--- " 24-12-31
-.-.- " 15-1-32

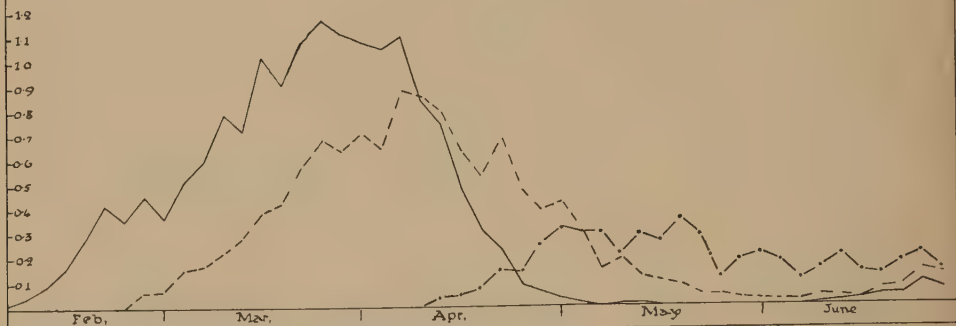
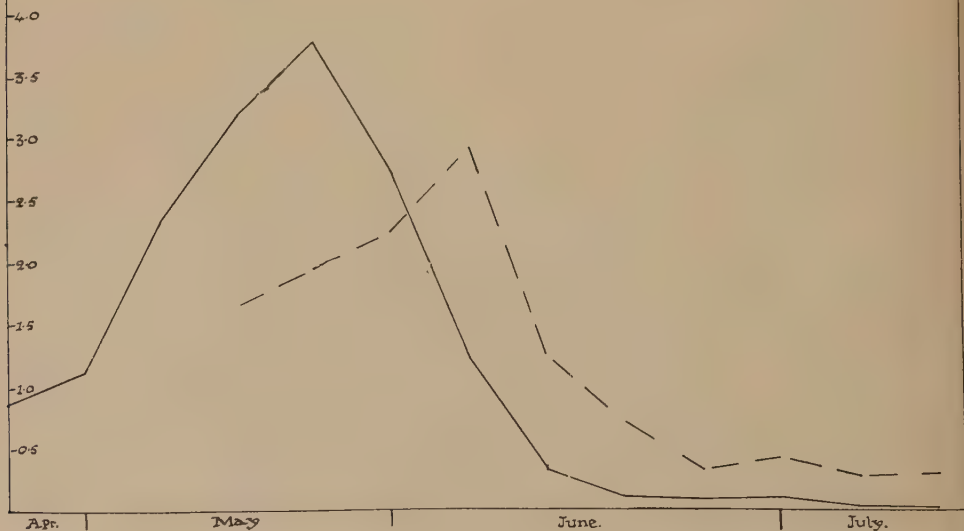


FIG 14

BOLLS PER PLANT
PER WEEK

— PLANTED 3-12-31
--- " 24-12-31
-.-.- " 15-1-32



The yield figures for the two trials are given in Tables 9 and 10. As in the time-of-planting experiments it was necessary to make allowance for differences in stand, and further, due to excessive soil erosion in one block during 1931-32, the figures for that block were discarded.

TABLE IX.
VARIETY TRIAL—1930-31.
RANDOMISED BLOCK—EIGHT REPLICATIONS.

<i>Variety.</i>	<i>Total of 8 plots (lbs. seed cotton).</i>	<i>Means.</i>	<i>Yield per acre (lbs. seed cotton).</i>
U.4/4/2	48.4	6.0	504
U.4/4	48.5	6.1	512
U.4/2	56.5	7.1	596
U.4/6	35.1	4.4	370
U.4/M.189	43.3	5.4	454
U.4	52.1	6.5	546

Standard Error of comparison of means of two strains = 0.75.

Difference required for significance ($P. = .05$) = 1.5.

TABLE X.
VARIETY TRIAL—1931-32.
RANDOMISED BLOCK—SEVEN REPLICATIONS.

<i>Variety.</i>	<i>Total of 7 plots (lbs. seed cotton).</i>	<i>Means.</i>	<i>Yield per acre (lbs. seed cotton).</i>
U.4/4	74.2	10.6	890
Z.9	74.8	10.7	899
U.4/2	78.6	11.2	941
U.4/6	63.4	9.1	764
955	58.4	8.3	697
U.4	65.1	9.3	781

Standard Error of comparison of means of two strains = 0.6.

Difference required for significance ($P. = .05$) = 1.2.

The main result which emerges from these two trials is that the comparatively early maturing strains U.4/2 and U.4/4 are significantly better than the late maturing strain U.4/6. This is also shown in the flowering and bolling curves for these three strains, given in Figs. 15, 16, 17, and 18. In the matter of maturation U.4/2 would appear to

be rather earlier under the conditions prevailing at Mazabuka than at Barberton. In both years U.4/2 also definitely proved superior to U.4 Bulk. One feature of the trial in 1931-32 was the failure of the very early maturing strain 955 which gave the lowest yield of all, significantly lower than U.4/2, U.4/4 and Z.9.

A short description of this strain as it has behaved on the Station during the season 1931-32 would appear necessary. The description is limited by the fact that the writers were on leave during the growing season. As may be seen from the flower and boll count figures it is earlier than the other strains. It produces an early flush of crop over a short period, as compared with a later, but prolonged setting by the other strains. In habit it is a small open plant which sheds its leaves comparatively early in the season. Judging from the preliminary indications of the effect of plant habit on the degree of stainer damage it was thought that this strain might be less stained than types of a more bushy habit.

An examination of all bolls picked from 20 plants per plot, making 160 plants for each strain, was carried out weekly on all strains in the variety trial. Degree of staining was expressed in the manner already described, and the figures for three strains are given in Table 11.

TABLE XI.

Week Ending.	U.4.		955.		U.4/2.	
	Total Locks examined.	% Locks stained.	Total Locks examined.	% Locks stained.	Total Locks examined.	% Locks stained.
26.4.31	558	66.1	1,551	85.0	765	79.1
3.5.31	718	35.9	966	38.1	1,016	42.3
10.5.31	1,115	28.1	1,673	25.0	1,490	30.8
17.5.31	2,161	23.3	2,114	23.1	2,634	24.6
24.5.31	1,616	23.6	1,419	25.9	1,950	22.5
31.5.31	1,685	33.2	1,176	41.0	2,092	38.3
7.6.31	863	61.6	556	66.4	1,015	58.9
14.6.31	421	80.5	291	88.0	507	83.8
	9,137	35.6	9,746	41.7	11,460	26.1

The results show that contrary to expectation 955 was more heavily stained than either of the other two strains. Height measurements of U.4 and 955 were taken, and U.4 was found to be significantly bigger than 955. The explanation would appear to lie in the fact that a very much larger proportion of the total crop carried by 955 was on the plants during the first attack of *D. supersticiosus*, than in the case of the other two strains. The latter produced a larger proportion of their crop during the period of minimum stainer population (see stainer distribution curves) resulting in a smaller proportion of loss due to this pest.

FIG 15

VARIETY TRIAL 1930-31

FLOWERS PER PLANT
PER DAY-3 DAY MEANS.

— $V_{4/2}$
- - - $V_{4/4}$
- · - $V_{4/6}$



FIG 16

BOLLS PER PLANT
= PER WEEK =

— $V_{4/2}$
- - - $V_{4/4}$
- · - $V_{4/6}$

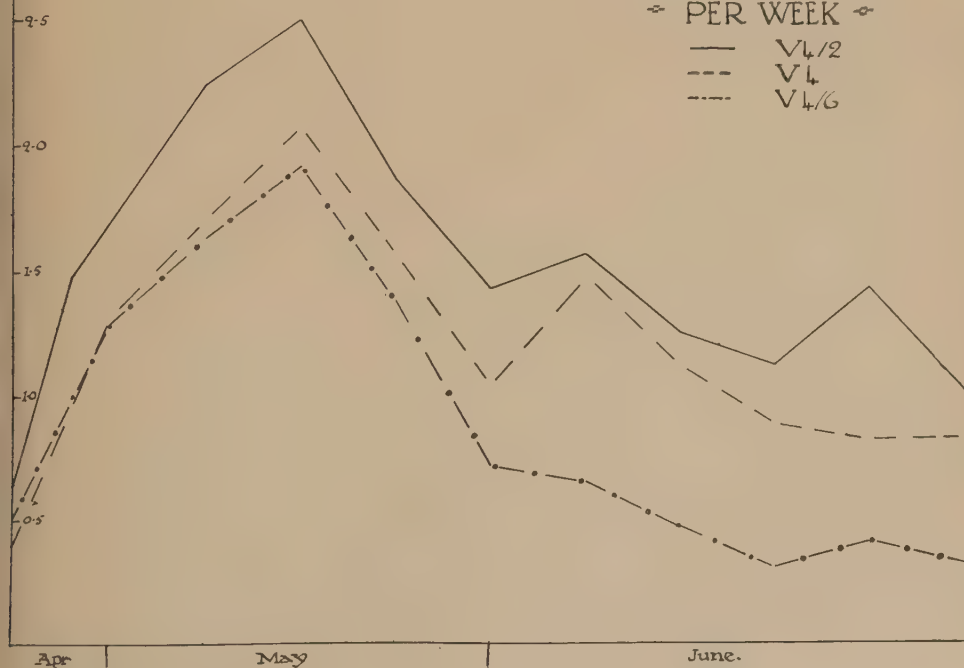


FIG 17

VARIETY TRIAL 1931-32

FLOWERS PER PLANT ~
PER DAY-3 DAY MEANS

- V₄
- - - 955
- - - V₄/6

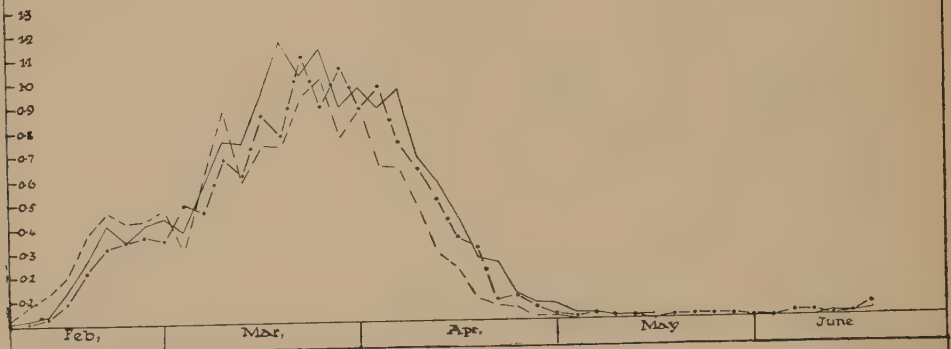
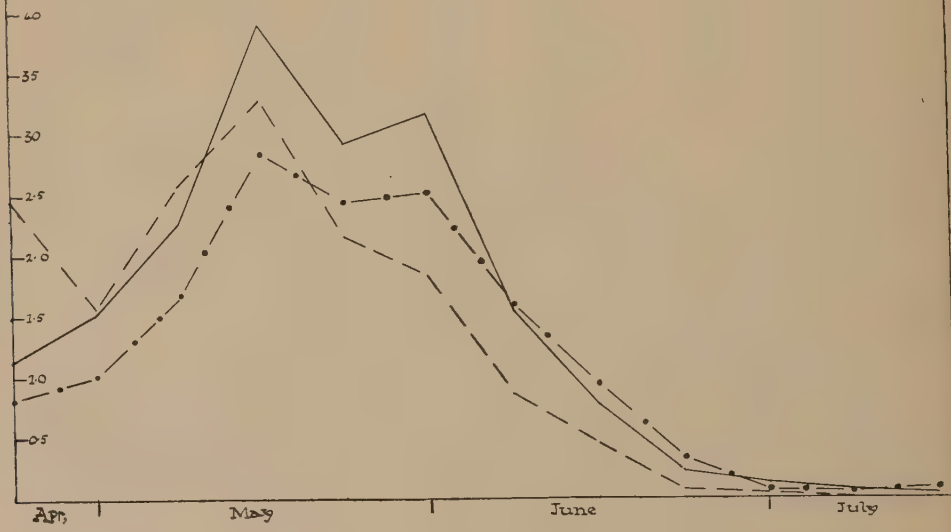


FIG 18

BOLLS PER PLANT ~
PER WEEK ~

- V₄
- - - 955
- - - V₄/6



SELECTIONS.

Selection has been continued in the past two seasons principally with the object of increasing yields. The results of this work have been extremely disappointing, and little progress has been made. The mainly early maturing selections planted in 1929-30 were almost completely destroyed by bollworm and stainer, while at the same time an indication was obtained that possibly a late maturing strain would be more suitable. (See "Reports from Experiment Stations, 1929-30"). In 1930-31 137 single plant lots drawn from U.4 and strains of U.4 were planted. In addition 34 small bulks were carried forward. In both the fields in which these were planted the soil differences described in the discussion of control of cotton stainer were encountered. Under these conditions strains which in the season 1930 had shown themselves to be almost identical in character behaved entirely differently. As a result, it was impossible to attempt to discriminate between strains as to yield capacity and lint quality. Selection was therefore restricted to representative types occurring on both soils. In all, 48 selections were carried forward. These strains were planted in mid-December, 1931, on a different field. Growing conditions were favourable and a good stand was obtained. Similar difficulty in the behaviour of the strains was again encountered. The prevailing soil type in the field produced a large bushy plant, which had again suffered severely from stainer attack, although not to the same extent as in the previous season. (See Stainer Distribution). Small patches of soil occurred which produced plants of the smaller type giving a heavy and relatively clean yield of cotton. The smaller types selected in 1931, when planted on the heavier soil in the present season, produced the large bushy type of plant, with a badly stained crop. It would appear that a small type of plant giving little shade may possibly assist in the solution of the problem of stainer damage, but at present it does not seem possible to maintain a small habit from one soil to another. On the other hand, the behaviour of the strain 955 during the present season has indicated that factors other than the mere habit of the plant are concerned and it is proposed to continue investigations on this point.

In view of the fact that soil differences play such a large part in determining the growth and habit of the plant, together with its subsequent reaction to insect pests, detailed selection is of little practical value at the moment. The present strains have shown themselves fully capable of producing a good crop, even in years of apparent heavy infestation by the two main insect pests, provided that soil conditions are such as do not encourage the heavy bushy type of plant.

SEED DISTRIBUTION.

In 1930-31 season, 29 farmers were each issued with sufficient seed to plant five acres of U.4 Bulk. For various reasons only sixteen plots were planted and of these four were abandoned. The average yield obtained was 256 lbs. seed cotton per acre, with a highest figure of 410 lbs. and a lowest of 66 lbs. The grades obtained were better than in either of the previous seasons. Seven bales were produced of which four were graded "Middling Fair" and three "Good Middling." The staple was $1\frac{1}{16}$ ".

As a result of the low prices ruling for cotton and the fact that the previous two crops remained unsold, farmers were very reluctant to put in cotton in the season 1931-32. Finally, seed was issued to seven, but of these only two lots were picked. The yields were very low. The grading of the crop baled this year, which consisted mainly of Research Station cotton was very satisfactory. The cotton was reported to be the best examined from Northern Rhodesia in the past three years. The grading obtained was "Strict Good Middling" with a staple of $1\frac{1}{8}$ ".

The yields obtained from the external plots grown by farmers do not compare favourably with those from the Station plots. This is largely due to the fact that the maize crop has been given primary consideration which has resulted in late planting and inadequate cultivation of cotton in the majority of cases. While the crop remains in an experimental stage, and at its present low price, the farmer shows little or no enthusiasm to put in cotton.

APPENDIX.

PRELIMINARY INVESTIGATION OF SOIL CONDITIONS.

BY

H. B. STENT.

The difference in the rate of growth of cotton plants on the two types of soil becomes visible when the plants are six to nine inches high. It would appear then that there is some marked difference in soil conditions in the surface layer. Each plot of a series was sampled to a depth of 6"—7" and the samples analysed.

There was found to be no appreciable difference in texture, available and HCl-soluble phosphate, exchangeable potash, or pH value between the eight plots, but a marked difference in total organic carbon and total nitrogen, the more pronounced vegetative growth accompanying higher carbon and nitrogen contents.

TABLE XII.

<i>Plot No.</i>	<i>Organic Carbon %.</i>	<i>Nitrogen %.</i>	<i>C/N Ratio.</i>
*B.1	0.35	0.055	6.4
*B.2	0.33	0.053	6.2
*B.3	0.39	0.051	7.6
*B.4	0.31	0.049	6.3
B.5	0.65	0.072	9.0
†B.6	0.60	0.055	11.1
B.7	0.74	0.077	9.6
B.8	0.59	0.060	9.8

* = Plot on Light Soil.

† = Plot on Intermediate Soil.

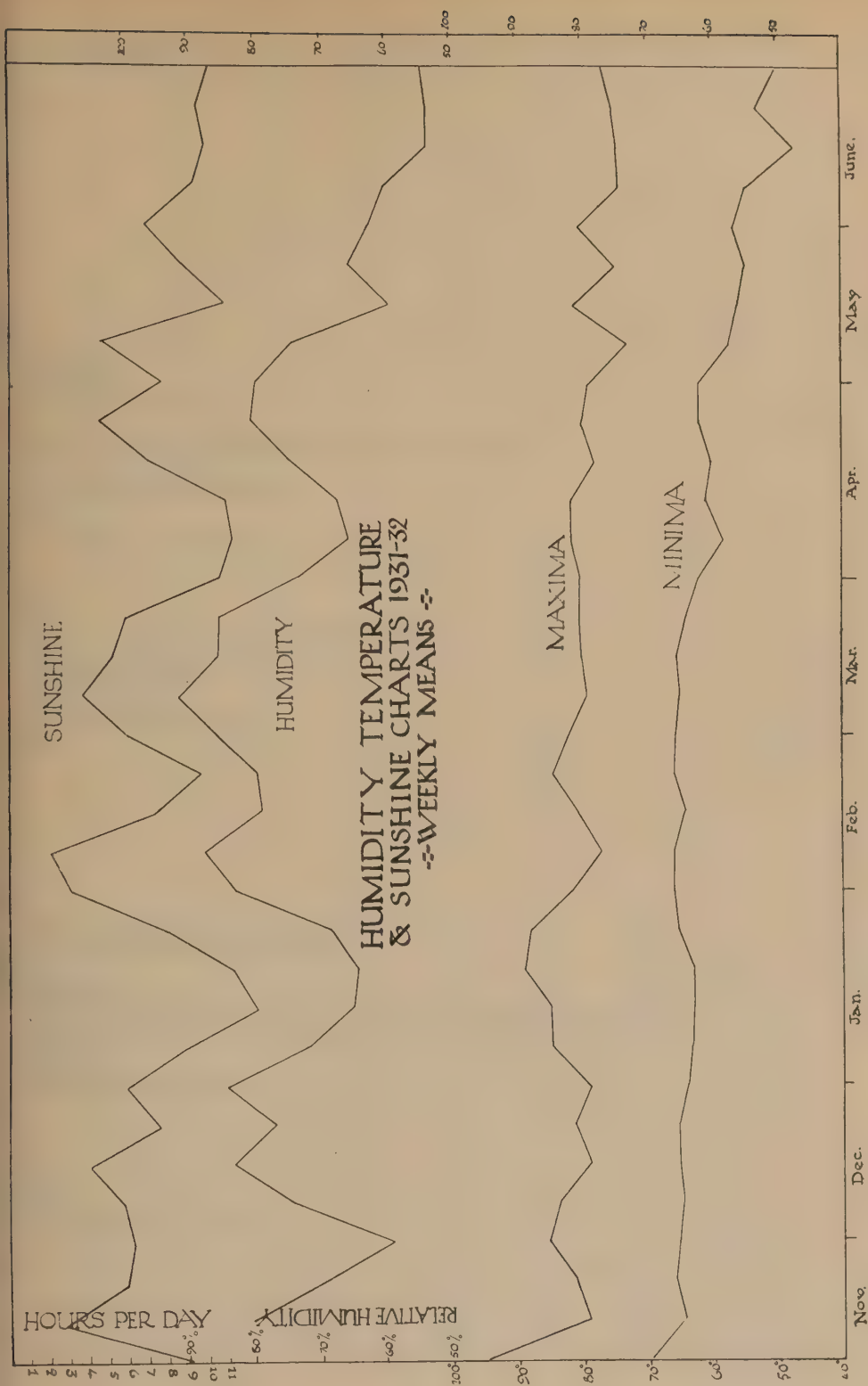
All the soil profiles were very similar, but as the investigation was made late in the dry season no reliable opinion can be formed with regard to drainage conditions. The soil is a fine sandy loam (coarse sand 14%, fine sand 69%) which packs down and becomes very hard on drying out. A hard layer of varying thickness is encountered at a depth corresponding roughly to the depth of ploughing. This compacted layer is so hard that plant roots have difficulty in penetrating into the subsoil. It is probable that such a hard layer will impede drainage. The chemical evidence, however, is sufficient to show that there may be greater micro-organic activity on the darker soil with greater nitrate production just when the plant makes a big demand for nitrogen. An attempt will be made to study the production of nitrate during the coming season.

DAILY RAINFALL.

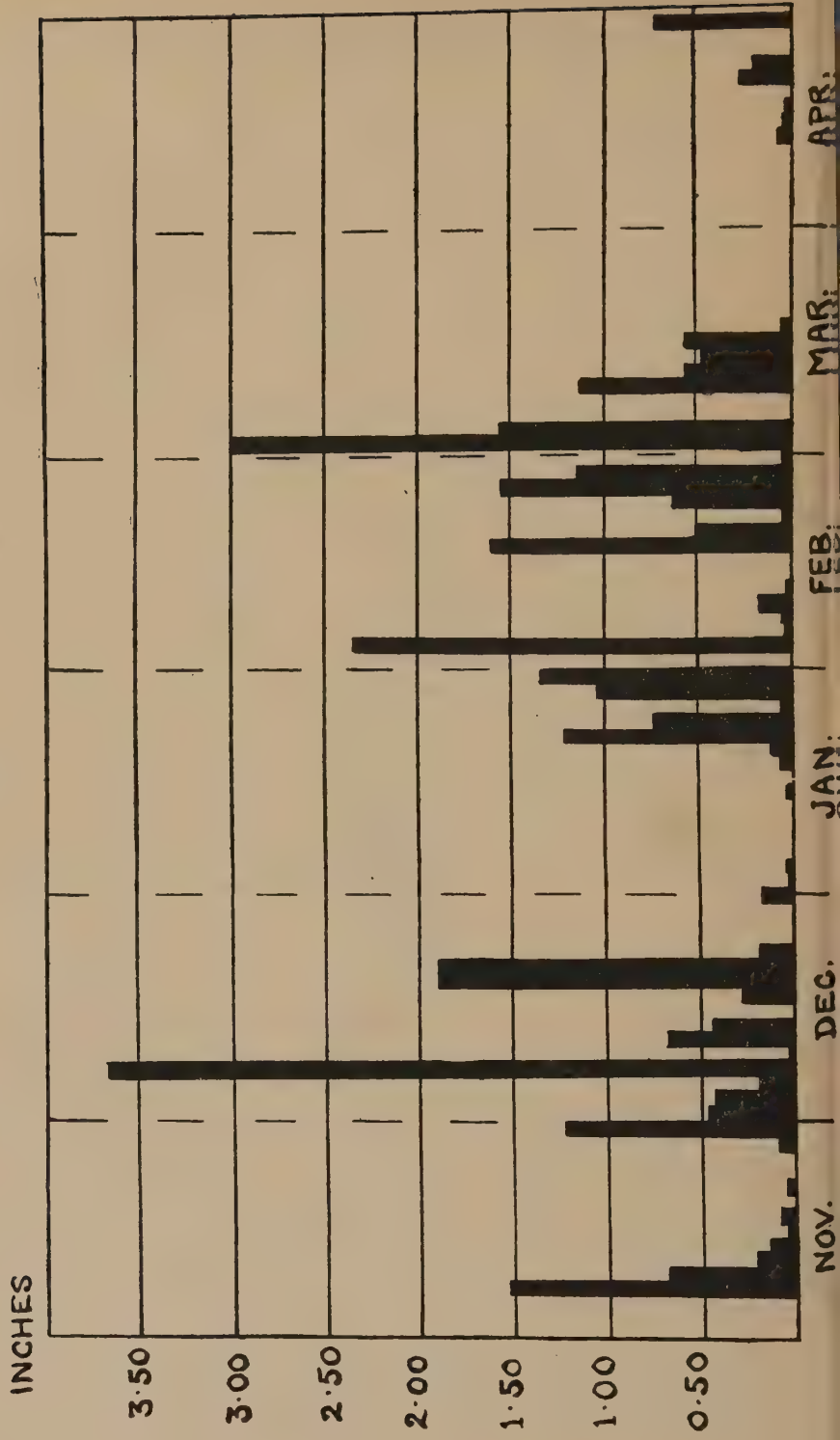
SEASON 1931-1932.

	<i>Jly.</i>	<i>Aug.</i>	<i>Sep.</i>	<i>Oct.</i>	<i>Nov.</i>	<i>Dec.</i>	<i>Jan.</i>	<i>Feb.</i>	<i>Mar.</i>	<i>Apl.</i>	<i>May.</i>	<i>June.</i>
1 ...	—	—	—	—	—	0-01	0-18	0-33	0-06	—	0-01	—
2 ...	—	—	—	—	—	0-47	Tr.	0-17	1-60	—	—	—
3 ...	—	—	—	—	Tr.	—	0-02	2-34	1-40	—	—	—
4 ...	—	—	—	—	—	0-41	—	—	1-44	—	—	—
5 ...	—	—	—	—	—	0-01	0-04	0-02	0-10	—	—	—
6 ...	—	—	—	—	Tr.	0-18	—	Tr.	—	—	—	—
7 ...	—	—	—	—	0-60	2-22	—	Tr.	Tr.	—	—	—
8 ...	—	—	—	—	0-92	1-46	—	0-04	0-08	—	—	—
9 ...	—	—	—	—	—	—	—	0-17	1-03	—	—	—
10 ...	—	—	—	—	0-67	0-01	—	0-02	0-16	—	—	—
11 ...	—	—	—	—	—	0-31	—	0-02	0-39	—	—	—
12 ...	—	—	—	—	0-20	0-38	—	—	0-23	—	—	—
13 ...	—	—	—	—	0-14	0-09	—	—	0-25	—	—	—
14 ...	—	—	—	—	—	0-33	0-03	—	0-25	0-06	—	—
15 ...	—	—	—	—	0-03	—	—	—	0-29	0-02	—	—
16 ...	—	—	—	—	—	—	—	—	0-02	0-02	—	—
17 ...	—	—	—	—	—	0-28	—	—	—	0-03	—	—
18 ...	—	—	—	—	0-06	—	—	1-60	—	—	—	—
19 ...	—	—	—	—	Tr.	—	0-06	0-01	—	—	—	—
20 ...	—	—	—	—	—	1-90	0-11	0-49	—	—	—	—
21 ...	—	—	—	—	—	1-81	—	0-03	—	0-27	—	—
22 ...	—	—	—	—	0-04	0-09	1-21	—	—	—	—	—
23 ...	—	—	—	—	—	0-14	Tr.	0-63	—	0-15	—	—
24 ...	—	—	—	0-11	Tr.	0-04	0-09	—	—	0-05	—	—
25 ...	—	—	—	0-04	—	—	0-66	0-62	—	—	—	—
26 ...	—	—	—	—	—	—	—	0-92	—	—	—	—
27 ...	—	—	—	—	0-10	—	0-04	0-47	—	—	—	—
28 ...	—	—	—	—	—	—	0-51	0-66	—	0-71	—	—
29 ...	—	—	—	0-03	0-07	—	0-52	0-14	—	—	—	—
30 ...	—	—	—	—	1-15	—	0-91	—	—	—	—	—
31 ...	—	—	—	—	—	—	0-42	—	—	—	—	—
Totals	—	—	—	0-18	3-98	10-14	4-80	8-68	7-30	1-31	0-01	—

Total for Season—36.40 inches.



RAINFALL-MAZABUKA, 1931-32 IN (2-DAY TOTALS)



ANGLO-EGYPTIAN SUDAN

REPORT ON THE WORK ON COTTON CARRIED OUT AT SHAMBAT BY THE PLANT BREEDING SECTION, GEZIRA AGRICULTURAL RESEARCH SERVICE, SEASON 1931-32

SUMMARY OF RESULTS.

BY

TREVOR TROUGHT.

PART I.—ORGANISATION.

- (a) *Staff*.—Mr. M. A. Bailey was appointed Controller of Agricultural Research on 1st April, 1931. Mr. T. Trought was appointed Chief Plant Breeder in his place, on October 11th, 1931.

Mr. L. A. Palmer replaced Mr. T. Cartwright as Farm Superintendent.

- (b) *Experimental Farm*.—The total cultivable area of the Farm is 92.42 feddans*, of which 25.89 feddans were under cotton. This does not include a 15-feddans Roguing Plot of Shambur IV grown on the riverain area of the Shambat Pump Scheme. Arrangements have been made for an extension of the Cotton area next season of approximately 19 feddans.

PART II.—GENERAL.

The cotton crop gave a satisfactory yield. The Roguing Plot of Shambur IV gave 4.7 large Kantars† per feddan (1,480 lbs. seed cotton per acre) and the average yield of the Preliminary Variety Test was 3.8 large Kantars per feddan (1,197 lbs. seed cotton per acre).

Conditions at sowing time were favourable, and little re-sowing was required. Rainfall was a little above normal. The plants made a good early start and little Blackarm was noticed. The plants finally attained a greater height than last year.

Leaf-curl attack was "patchy" and not severe.

The season was reasonably normal, October being somewhat warmer, and January rather cooler than average.

* 1 Feddan = 1 acre (approx.).

† 1 large Kantar = 315 rottles seed cotton.

1 small Kantar = 100 rottles ginned lint.

1 rottle = 1 lb. (approx.).

Locust damage was negligible but Sudan bollworm did some little damage. The attack of Pink bollworm was more severe.

Mr. R. L. Knight visited the Experimental plots in Kordofan and Mongalla.

PART III.—EXPERIMENTAL.

I. COTTON BREEDING.

(a) Egyptian and Sea Island Types.

- (i) *Leaf-Curl*.—The incidence of leaf-curl at Shambat was not severe, and few infected plants showed severe symptoms. Two infections of leaf-curl on Asiatic types were found, which are believed to be the first records of leaf-curl on Asiatic cottons.

At the Gezira Research Farm the percentage of leaf-curl attack approached 90%, but there also individual attacked plants did not show the usual severity in their symptoms.

Final counts in the Breeding Plots at Shambat were made on sprouting ratoons after the plants had been cut back. Many fresh infections were recorded.

As the total infections in the Line Test only showed an average of between 11% and 12%, and incidence was "patchy," the comparative "resistance" figures at Shambat are of much less value than those at the Gezira Research Farm. At that place the control rows of Sakel showed an average percentage infection of 85%, while Shambur IV, X.H.1029 and X.H.1229 gave 8.5%, 13.5% and 15.5% of infected plants respectively.

In the Observation Plot at Shambat there was a strong indication that there was a greater development of leaf-curl in the more vigorous parts of the plot. This may mean that environment has an effect on the development of visible symptoms of leaf-curl, as well as the constitution of the plant.

- (ii) *Egyptian and Sea Island Breeding Plots*.—The following table gives the number of families grown and the number of plants selected as parents of families next year :—

	<i>No. of families grown in 1931-32.</i>	<i>No. of plants selected for growing next year.</i>
New Selections	38	30
Egyptian and Sea Island P.L's ...	52	72
Hybrid Plot	50	69

A number of types from Fiji have been sent by Mr. R. R. Anson, and a new selection by Mr. A. R. Lambert from the Gezira will be grown.

Intensive self-fertilisation of flowers was resorted to as in previous years, and in some instances complete netting was tried. When complete nets were put on later in the season than had previously been tried, in most cases a satisfactory quantity of self-bred seed was obtained.

A total of 1,496 plants were brought into the laboratory for examination from the breeding plots.

A number of families showed up well in the field (10/30, 15/30, and 17/30 derivatives). Family 37/31 was highly resistant to leaf-curl. A Tanguis family in the New Selection Plot showed no leaf-curl.

In the Hybrid plot, families seemed more resistant to leaf-curl on the whole, but the bolls had generally a bad opening tendency. Selections of better boll openers were made. Families H.17/31 (an X.H.1029 type) and H.20/31 (an X.H.1229 type) were selected for bulking.

(iii) *Parallel Cultures at the Gezira Research Farm.*—Observations were made on these for comparison with similar types grown at Shambat.

(b) American and other types.

(i) *Breeding Plots.*—The following table gives the number of families grown, and the number of plants selected as parents for next year :—

	<i>No. of families grown in 1931-32.</i>	<i>No. of plants selected for growing next year.</i>
New Selections	20	17
American P.L's	28	37
American Hybrids	4	11

The growth in this plot was satisfactory, though in some families bad "lodging" occurred later in the season.

Individual families from selections from Pump Scheme Strain, X.A.1129 strain, and X.A.02629 strain all showed up satisfactorily.

The F.2 generation from the Pedigree Dixie × Lone Star cross was examined in detail, and a number of selections made for further trial, from plants possessing the desired combination of high ginning out-turn and long staple.

II. COTTON PROPAGATION.

(a) Egyptian and Sea Island Types.

(i) *Increase Area.*—An area of 60 feddans of Shambur IV was grown on the Sudan Plantations Syndicate's Seed Farm at Barakat.

- (ii) *Roguing Plot*.—At Shambat 15 feddans of Shambur IV was grown and rogued.
- (iii) *Bulk Propagation Plots*.—X.H.1029 and X.H.1229 were propagated on areas of $2\frac{1}{2}$ and 2 feddans respectively at Shambat. The area of X.H.1229 included approximately half a feddan from self-bred seed. These were rogued twice.

From leaf-curl resistant plants at Shambat and in the Gezira, small bulkings were made and grown at the Gezira Research Farm, under the term "Lecrem". One "Lecrem A" type has been continued.

Some types were propagated for testing including X.1530. The seed from the X.1530 plot will be used for a Roguing Plot in 1932-33.

(b) *American Types*.

- (i) *Increase Area*.—Delrect I was sown on the main area (375 feddans) of the Bouga Pump Scheme, and rogued once.
- (ii) *Roguing Plots*.—Delrect II was sown on a 20-feddan plot at Bouga.
- (iii) *Nucleus Roguing Plots*.—At Shendi and Shambat the following types were propagated:—X.A.129, X.A.1129, X.A.02629, X.A.2529, Parnell's U.4 and X.A.2829.

III. VARIETY COMPARISONS, INSPECTION PLOTS, ETC.

(a) *Egyptian and Sea Island Types*.

- (i) *Standard Test Series*.—There were three of these Standard Tests, one each at Shambat, Barakat and Wad Medani.

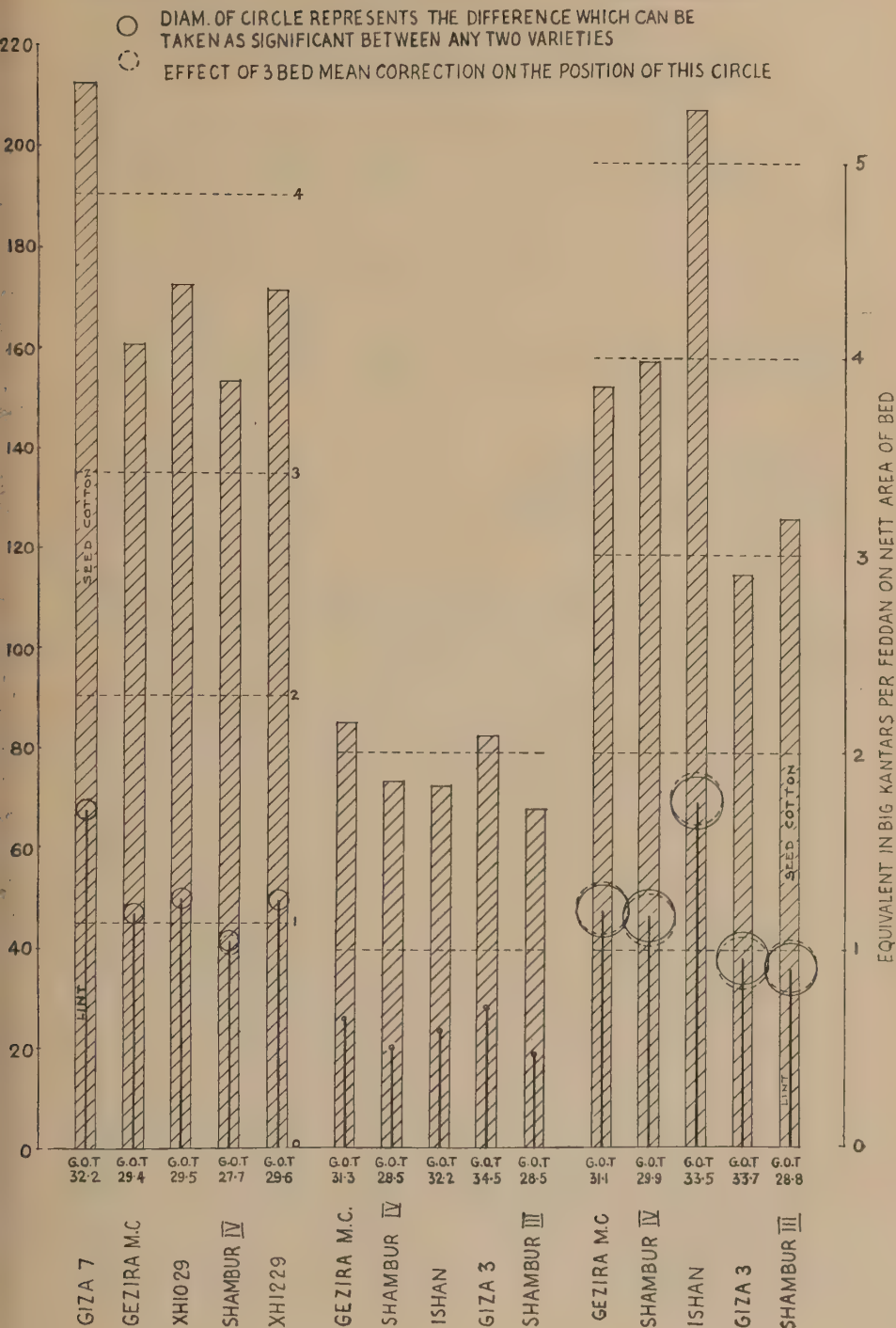
The yields of these three experiments are expressed diagrammatically in Fig. I. The diagram shows the average yield per bed in rottles of seed cotton, with the equivalent yield per feddan in large Kantars. The ginning out-turn for each variety is shown, and the vertical line shows the actual weight of lint after ginning from which the G.O.T. was calculated. The circles drawn are to scale, and their diameters show the magnitude of the difference which the statistical analysis of the results gives as "significant." Inspection of the diagram thus shows immediately whether the difference between any two varieties is significant. Thus, in the Barakat Experiment, the circles of Gezira Main Crop and Shambur IV overlap, so the difference is not significant. The circle for Shambur III, on the other hand, fails to overlap the Gezira Main Crop circle; the difference between these two types is

FIG. 1

SHAMBAT

MEDANI

BARAKAT



significant. This form of diagrammatic representation is due to Mr. H. E. King, Plant Breeder, Sudan Government, and shows the results very compactly and clearly for ready reference.

The following table indicates which of the types were sent to England for grading, and gives the cash return per feddan for lint only, calculated on the basis of the grader's valuation.

Sample.		Grader's Valuation.	Cash return per feddan at		
			Barakat.	Wad Medani.	Shambat.
From Barakat	Gezira Main Crop				
	Sakel ...	8-00d. per lb.	£7-88	£4-45	
	Shambur IV ...	9-75d. " "	£9-55	£4-32	
	Ishan ...	5-60d. " "	£8-07	£2-73	
From Shambat	Gezira Main Crop				
	Sakel ...	8-50d. " "			£ 8-35
	Giza 7 ...	8-00d. " "			£11-36
	X.H.1029 ...	9-75d. " "			£ 9-92
	X.H.1229 ...	10-50d. " "			£11-08
	Shambur IV ...	10-25d. " "			£ 9-03

X.H.1229 would appear to be the most promising type of those tested, as it has, in addition to a staple equal to or rather better than Sakel, an equal yield of lint per feddan, and considerable leaf-curl resistance.

- (ii) *Line Test at Shambat.*—Judged on yield of ginned lint, types X.0530, X.01230, X.04729, X.730, X.1530 and X.1730 were superior. X.01230 has inferior lint, X.1530 and X.1730 are similar to Sakel and X.04729 has longer lint than Sakel.

X.H.730, X.H.830, X.H.1130, X.H.1029, X.H.1229, X.1030 and X.0730 were similar in yield to the control, but somewhat superior in other respects.

- (iii) *Line Test and Inspection Lines at the Gezira Research Farm, Wad Medani.*—These experiments are part of the Plant Breeding Extension work in the Gezira, and provide useful data for comparison with parallel experiments at Shambat.

IV. SPINNING TESTS AND GRADER'S REPORTS.

We are particularly indebted to Mr. Charles Wolstenholme for both the Egyptian and American grading Reports, and to the Fine Cotton Spinners' & Doublers' Association for the Egyptian spinning tests carried out in their Experimental Department.

Spinning Tests 1930-31 Crop.—The following table summarises the results of the more important types.

Order of Merit.	Variety.	Count $\times$ Strength Product.			Total Waste %.	Grader's valuations.
		Singles.		Twofold.		
		T.F. 2.75.	T.F. 3.6.			
1	X.H.1229 ...	1,670	2,020	3,150	21.3	8.76d.
2	X.H.1029 ...	1,630	1,950	3,020	22.9	8.01d.
=3	Gezira Main Crop Sakel	1,510	1,910	3,040	22.9	7.26d.
=5	Shambur IV ...	1,450	1,830	2,970	23.9	7.26d.

Grading Tests, 1930-31 Crop.—X.H.1229 headed the list in samples submitted from the Standard Varietal Tests, but in samples submitted from the Line Test, X.0730, X.H.529, and X.H.1130 were rated higher than X.H.1229.

(b) American Types.

- (i) *Standard Test Series.*—Two experiments were carried out in the Nuba Mountains district at Talodi and Kadugli, and two in Mongalla at Opari and Kirrippi.

The yields of seed cotton, yields of lint, ginning out-turns and significant differences of the varieties tested are shown in Fig. II. From the diagram it is seen that the differences in the Nuba Mountains are not significant, with the possible exception at Talodi of X.A.2728 over Pump Scheme Strain, and at Kadugli of Pump Scheme Strain over X.A.1129.

At Kadugli, the variety Pump Scheme Strain was unduly favoured by circumstances, as it happened to escape damage by flooding in two beds, and a third bed had an isolated "vigour patch."

The following table gives the monetary return per feddan calculated from the lint yields and grader's valuations.

Variety.	Grader's Valuation in pence per lb.		Return per feddan at			
	Talodi.	Kirrippi.	Talodi.	Kadugli.	Kirrippi.	Opari.
Pump Scheme Strain ...	5.95		£5.61	£7.90	—	—
X.A.2728 ...	5.90		£6.96	£6.93	—	—
X.A.1129 ...	6.50		£6.85	£6.71	—	—
X.A.129 ...	5.70	5.80	£6.43	£6.94	£4.28	£4.77
X.A.2529 ...	6.40	6.05	£6.37	£7.34	£2.99	£2.93
Parnell's U.4 ...		5.70	—	—	£4.98	£5.37
Uganda S.G.29		6.05	—	—	£4.85	£4.54
Pump Scheme Strain ...		5.85	—	—	£3.96	£3.18

FIG. 2

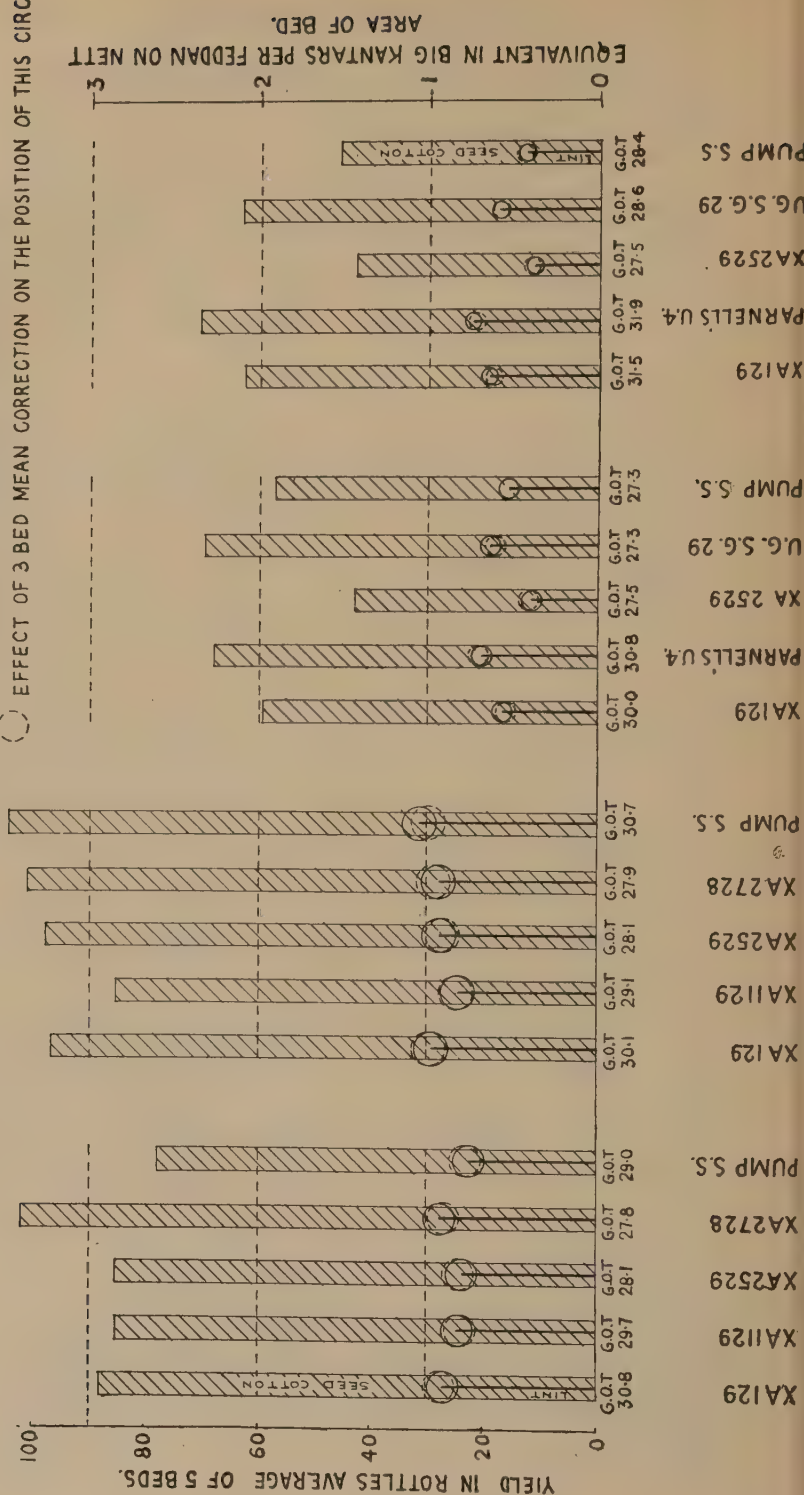
TALODI

KADUGLI

KIRRIPI

OPARI

- DIAM. OF CIRCLE REPRESENTS THE DIFFERENCE WHICH CAN BE TAKEN AS SIGNIFICANT BETWEEN ANY TWO VARIETIES.
- EFFECT OF 3 BED MEAN CORRECTION ON THE POSITION OF THIS CIRCLE.



- (ii) *American Line Test*.—X.A.2730, X.A.2728 and X.A.02629 gave yields more than 50% greater than the control.

X.A.02629 was remarked as being the most attractive plant vegetatively.

- (iii) *Spinning and Grading Tests*.—We are indebted, as mentioned earlier, to Mr. Charles Wolstenholme for grading the samples, and to the British Cotton Industry Research Association for the results of the Spinning tests, which this year have been received in time for inclusion in this report.

Grading Tests.—Of samples sent from the Talodi Varietal Test, X.A.1129 received the highest valuation and X.A.2529 came second. Pump Scheme Strain beat X.A.129.

From Kirripi X.A.2529 and Uganda S.G.29 samples were valued at the same price, but as the S.G.29 grade was a little lower, the intrinsic value of S.G.29 should probably be rated a little higher. (X.A.1129 was not included in the Kirripi test). X.A.129 was graded the lowest. This is of interest in view of its good performance in the spinning tests.

Of cottons grown under irrigation, at Shendi and Shambat, X.A.630 and Delrect II were valued highest of the Shambat samples and X.A.02629 highest of the Shendi samples.

Spinning Tests on 1930-31 Samples.—A total of 22 samples were sent, and on these samples 48 different tests were carried out. Summarising briefly the spinning test reports, in general the yarns were fair, but not equal to the Memphis control, the only one which challenged this being X.A.1129. X.A.1129 seemed to be a satisfactory sample in all respects. Most of the samples would be commercially spinnable to 60s., the exceptions being X.A.2728, U.4 and S.G.27. X.A.1129 and Pump Scheme Strain suffered least from neppiness.

As the agricultural properties of X.A.1129 were also satisfactory, arrangements have been made for more extended trials.

Spinning Tests on 1931-32.—Twelve samples were sent on which 25 different tests were carried out.

In the rain-grown samples X.A.129 showed up well in spite of its shorter staple, X.A.1129 was better in yarn strength, hair weight per centimetre, and effective length; but in view of a possible tendency to neppiness was not definitely considered superior to X.A.129. As X.A.1129 would probably spin to 70s., there seems little between the two types on this year's results.

In the irrigated samples, the yarns suffered from the presence of bits of seed coat, etc. This may have been due to a heavy Pink bollworm attack on the Northern Pump Stations.

X.A.02629 was outstanding in strength at 64s and 80s., and was the only one which spun well at 80s.

U.4.4.2 gave weak yarns, poor in appearance.

Fibre Tests on 1930-31 and 1931-32 Samples.—The feature of the 1930-31 examination was the high percentage of dead hairs in Delrect II when grown under rainfall conditions. X.A.1129 appeared to be the best all-round cotton of the series (grown under irrigation).

For the 1931-sown samples, the Kirripi samples had higher hair weights per centimetre and more completely thickened hairs than the Talodi samples.

This was reflected in the superior yarn strengths of the Talodi samples.

The irrigated cottons had hair weights of the same order as those at Kirripi.

IV. MISCELLANEOUS AND MINOR EXPERIMENTS.

These included :—

- (a) Delayed Picking Experiment. (b) Shade Experiment.
(c) Observation Plot. (d) Nep prevention Experiment. (e) Varietal Nep Experiment. (f) Comparison of different selfing methods.

(Included by courtesy of the Uganda Government.)

UGANDA

REPORT OF THE COTTON BREEDING SECTION DEPARTMENT OF AGRICULTURE SEASON 1931-32

SUMMARY OF RESULTS.

BY
G. W. NYE AND H. R. HOSKING.

1. GENERAL.

No change was made from the general scheme of work adopted in 1929.

Progress was made with the distribution of the strain S.G.29 which has given satisfactory results and has remained true to type.

The staff was the same as in the previous season, except that Mr. Irving, Agricultural Officer, assisted the Cotton Botanist at Bukalasa during the picking season.

2. BUKALASA ZONE.

Meteorological Conditions.

At planting these were very favourable, resulting in excellent germination. Subsequent weather was decidedly variable with alternating dry and wet periods which caused heavy shedding of buds and bolls. Very hot and dry conditions after mid-December resulted in premature boll opening with the consequent production of immature lint and many motes.

Insect Pests and Diseases.

The outstanding insect pest in this zone was *Lygus*, which caused very heavy bud shedding, especially on old land. No resistance was observed.

Stainers, bollworms, and jassids were present as usual, but were not responsible for much loss of crop.

Blackarm.—This disease was rather more in evidence in Buganda than in past seasons, but it is at present a far less serious problem than it is in the Eastern Province.

Breeding Plot.

(i) New Selections.—The most promising of these were re-selections from B.31 and B.39 which showed high resistance to Angular leaf spot and blackarm.

Several U.4 families promised well, but appeared to be particularly susceptible to boll shedding. Families of B.45 and B.53, although susceptible to blackarm, yielded very well and gave a fine quality lint.

(ii) Pedigree Lines.—Selected B.31 exhibited almost complete resistance to angular leaf spot and blackarm but gave a poor yield. A U.4.4.2 selection also showed high resistance coupled with good yielding powers.

Increase Plots.

Selected S.G.27, although late planted, yielded well and promised to be a distinct improvement on the original S.G.27.

Variety Trials.

(i) Bukalasa.—This trial consisted of an 8×8 Latin Square and gave good results. S.G.27 and B.16 showed significantly less initial infection by angular leaf spot than other varieties. S.G. 27's apparent resistance is probably due to the seed having been stored for two years.

The final yield results showed S.G.23/8 and N.3/5 to give significantly higher yields than all the other varieties; the Local Strain was significantly better than S.G.27, S.G.29, B.16, U.4, and S.G.27.15.13., S.G.23/8 and N.3/5 also gave a significantly higher percentage of first quality cotton than any of the other varieties while U.4 was the worst in this respect.

S.G.23/8 again exhibited its low rate of boll shedding and its results are distinctly promising as it possesses better spinning qualities than any other strain we have so far worked with in Uganda.

(ii) Outside Trials.—Smaller variety trials were conducted at four centres in Buganda, but no significant results were obtained from any of them.

Interchange of Seed Experiment.

The first results from this experiment have been obtained. No effect on yield resulted from growing a variety out of its original environment for one year, but from the Bukalasa Section of this experiment it appears that temporary transfer of a variety increased its susceptibility to angular leaf spot, which shows up in the amount of primary infection in the following year. Other results indicate that seed originating from Bukalasa germinated better than that originating at Serere. No effect on quality has yet been observed.

Spinning Tests, etc., 1930-31 Crop.

S.G.23/8 from both Bukalasa and Serere gave easily the best results at all counts up to 70's, while U.4 was the least satisfactory. S.G.29 spun better at higher counts than at lower ones.

Place effect is noticeable in measurable characters. Bukalasa giving a longer staple and lower hair weight per centimetre than Serere while Serere gave a lower percentage of dead hairs than Bukalasa.

3.—SERERE ZONE.

Meteorological Conditions.

The rainfall was very irregular and caused a marked decline in the yield of those areas lying north of Lake Kioga in the Eastern Province.

Angular leaf spot spread rapidly during a wet period—the months of May to August inclusive. A drought during October checked the blackarm, but favoured the increase of jassids to very large numbers. The dry spell subsequent to December 9th prevented the second flowering peak maturing its bolls.

Diseases and Pests.

Blackarm. — This disease was rather more serious in the northerly part of the Eastern Province as compared with the previous season.

Jassids.—The dry spell in October brought on a heavy attack of jassids. Marked reddening of the leaves occurred. S.G.23.8 again showed itself to be very susceptible.

Heliopectis bergrothi.—This pest is on the increase. Parts of Lango and Chua were badly infested, and the reduction in the yield of those areas can be attributed very largely to this insect.

Stainers (Dysdercus spp.) were rather more numerous than usual and caused a high percentage of stained cotton.

The remaining pests, lygus and spiny boll worm, (*Earias sp.*), were normal.

The Breeding Plot.

The New Selection strains originating from S.G.129 were again the most successful in respect to yield and resistance to blackarm disease. Promising re-selections have developed from Cambodia; these are very resistant to jassid and show good recovery from blackarm under suitable conditions.

In the Pedigree Lines, S.P.13—a re-selection from Parnell's U.4.4.2—gave the best yield and highest resistance to jassid. The lint is

not yet up to Uganda standard, although it is a distinct improvement on the original U.4 bulk. S.P.13 was also earlier than the other pedigree lines.

The Blackarm Experiment.

This experiment was carried out at Serere and Kampala. It was designed at Rothamstead by Dr. R. A. Fisher, R. H. Stoughton and the writer. It was found that showers of rain with high rate of fall per unit time gave the highest correlation with increase of secondary infection and spread of the organism.

Sulphuric acid-treated seed gave the lowest percentage of primary infection. There was no difference between the percentage of primary infection of normal (untreated) seed and seed dusted with a mercuric compound, although the latter gave the highest initial germination of all treatments. Seed steeped in a strong emulsion of *B. malvacearum* gave the highest primary infection.

By the time secondary infection appeared, there was no real difference between the four "treatments."

Sulphuric acid appears to depress the yield of seed-cotton, but no significance was obtained.

Seed Increase.

The strains S.P.1, S.P.4 and S.G.27 were run up in quarter-acre plots and gave good yields.

The 30 acres of the Serere Main Farm were again planted with S.G.29. The yield was low, being only 300 lbs. seed cotton per acre.

The Mulondo Segregated Area gave 186,635 lbs. of S.G.29 seed-cotton and averaged 434 lbs. per acre. The grade was rather lower than usual.

Variety Trials.

Serere.—No significance was obtained between the final yields of the six varieties included in this trial, owing to the unfortunate arrangement of the randomised blocks. N.17 gave the best germination—this was very significant, although U.4 gave the highest yield. S.G.29 also gave a slightly higher yield than N.17.

Outside Trials.—Seven similar 4×4 Latin Squares were laid down at different centres scattered over the Eastern Province. The Statistical Department of Rothamstead very kindly calculated the results. U.4 was significantly better than the other three varieties (S.G.29, S.G.27 and N.17), and S.G.29 was significantly better than N.17. There was no significance in the interaction between variety and centre, except at the high-yielding centre Labori, where U.4 yielded more than was to be expected.

This system of replication of the same experiment proved very satisfactory, as only one centre gave significance when each trial was treated separately, yet when all were combined very high significances were obtained.

Quarter-Acre Comparisons of S.G.29 and N.17.

The yield figures for the fifty quarter-acre comparisons of S.G.29 and N.17 are now available for the two seasons 1929-30 and 1931-32. No statistical significance between the two varieties was obtained, although the balance was in favour of S.G.29. From these results it has been possible to divide the Eastern Province up into "yield-areas" showing significant differences in yield. In the low-yielding group, S.G.29 gave a larger increase over N.17 than in the high-yielding group of "yield-areas." During the bad blackarm year, 1929-30, the difference in favour of S.G.29 was greater than in the season under review. This might point to S.G.29 being rather more resistant to blackarm than N.17.

There appear to be some areas where S.G.29 is unsuitable. However, when the results of the Outside Variety Trials (see above) are taken into consideration, we can say that nothing will be lost by the introduction of S.G.29 throughout the Eastern Province. This conclusion applies to yield per acre only.

General.

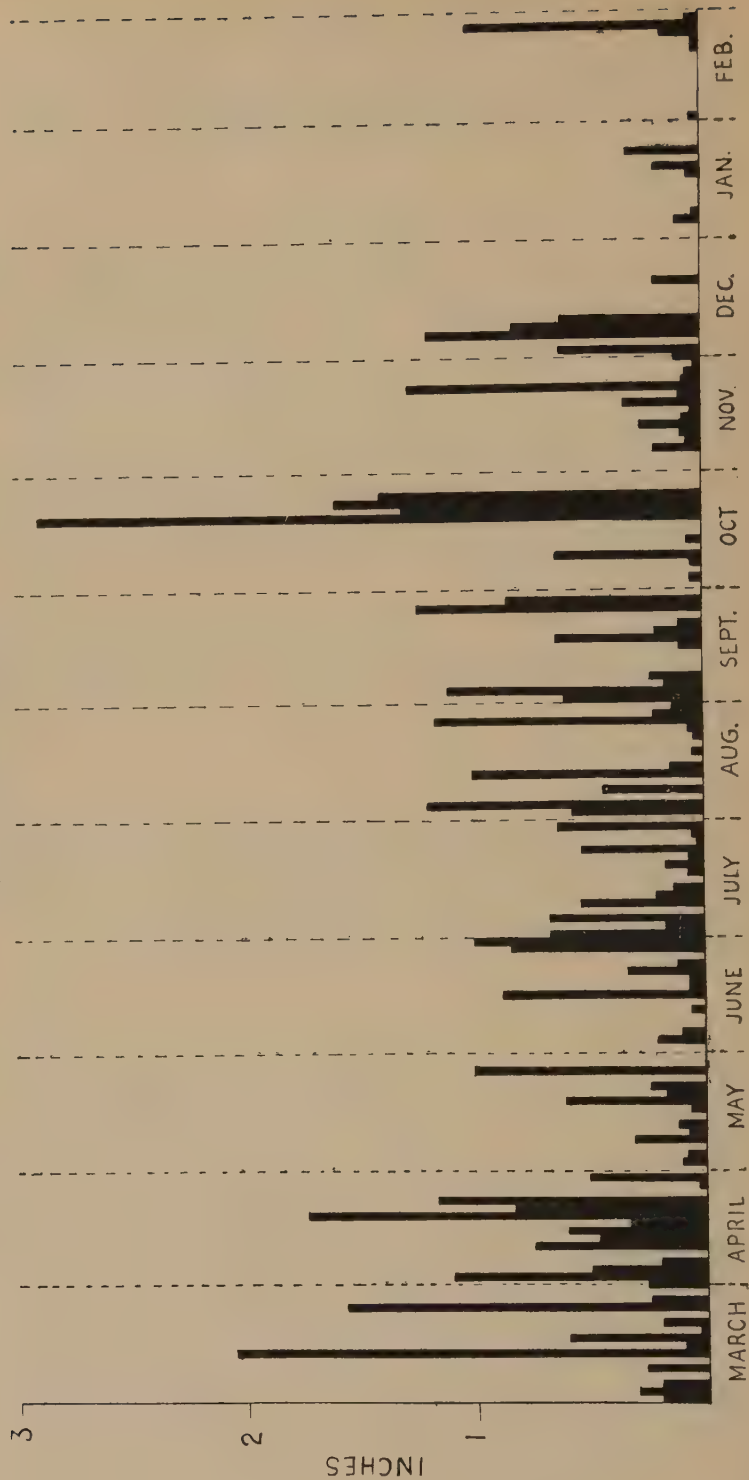
The season was a bad one for the Eastern Province as a whole, although Busoga gave a very good yield.

The general grade was distinctly below average due to the higher proportion of stained cotton and reduced yield.

BUKALASA RAINFALL

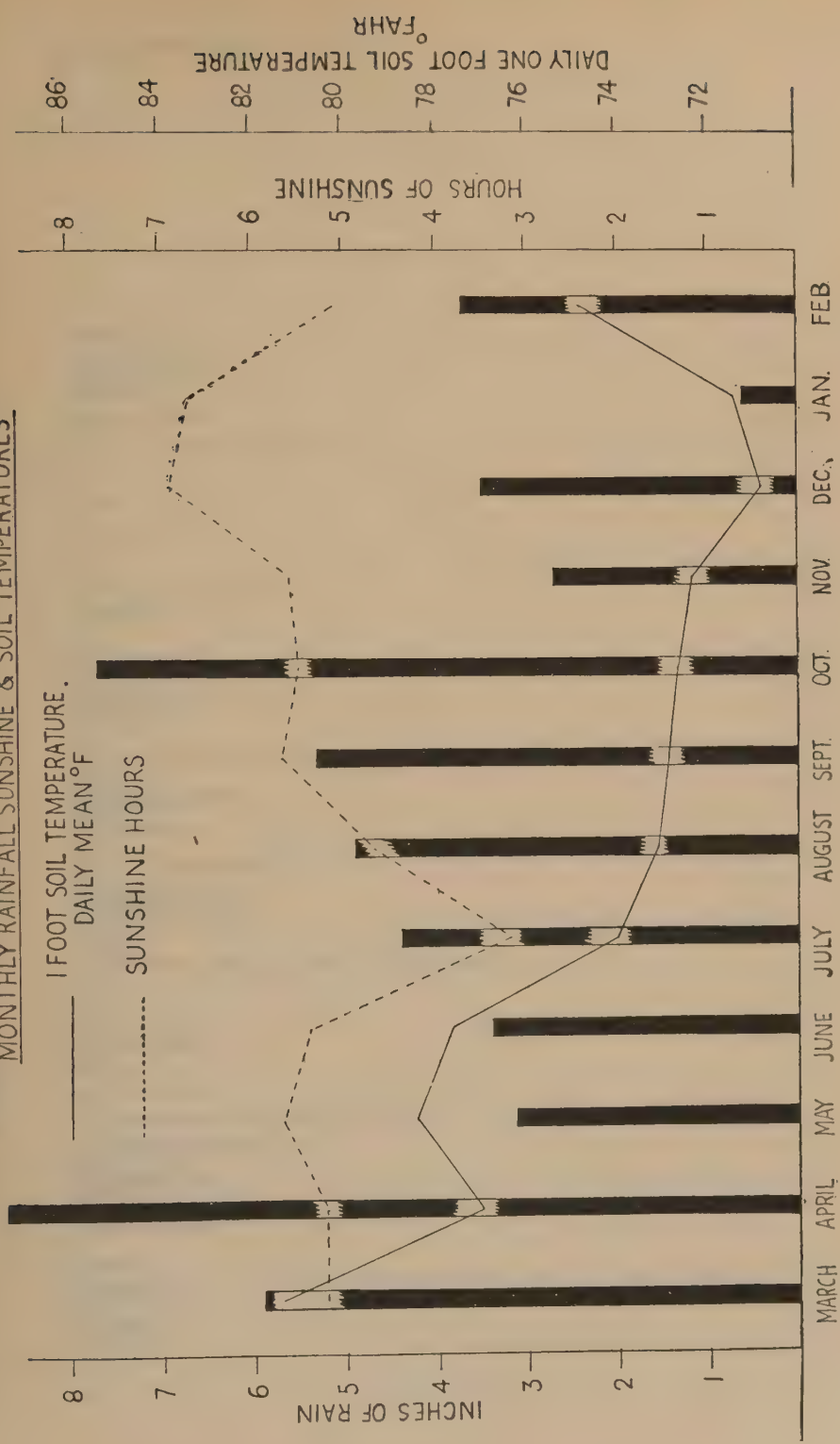
1931-32

2 DAY TOTALS

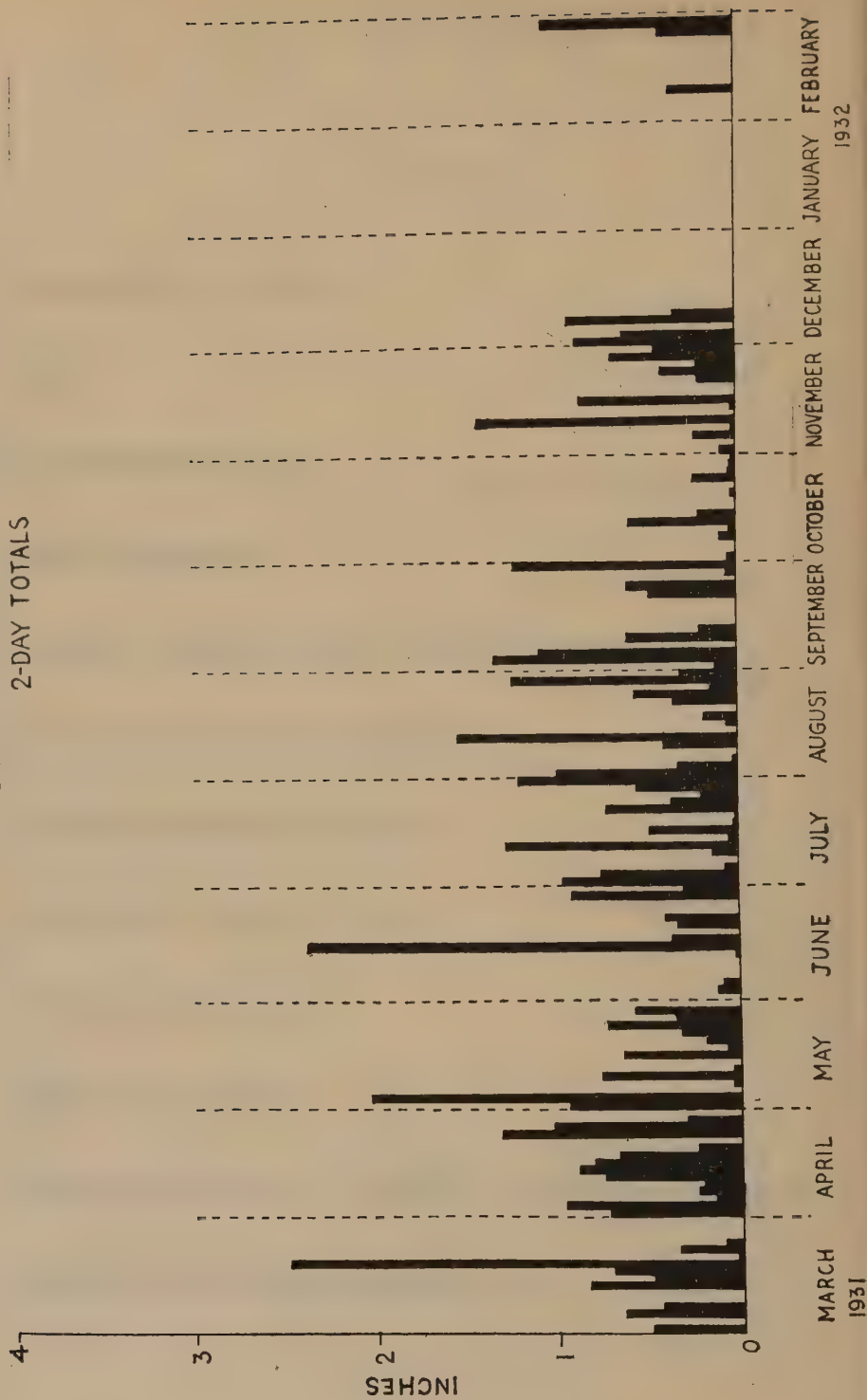


BUKALASA 1931-32.

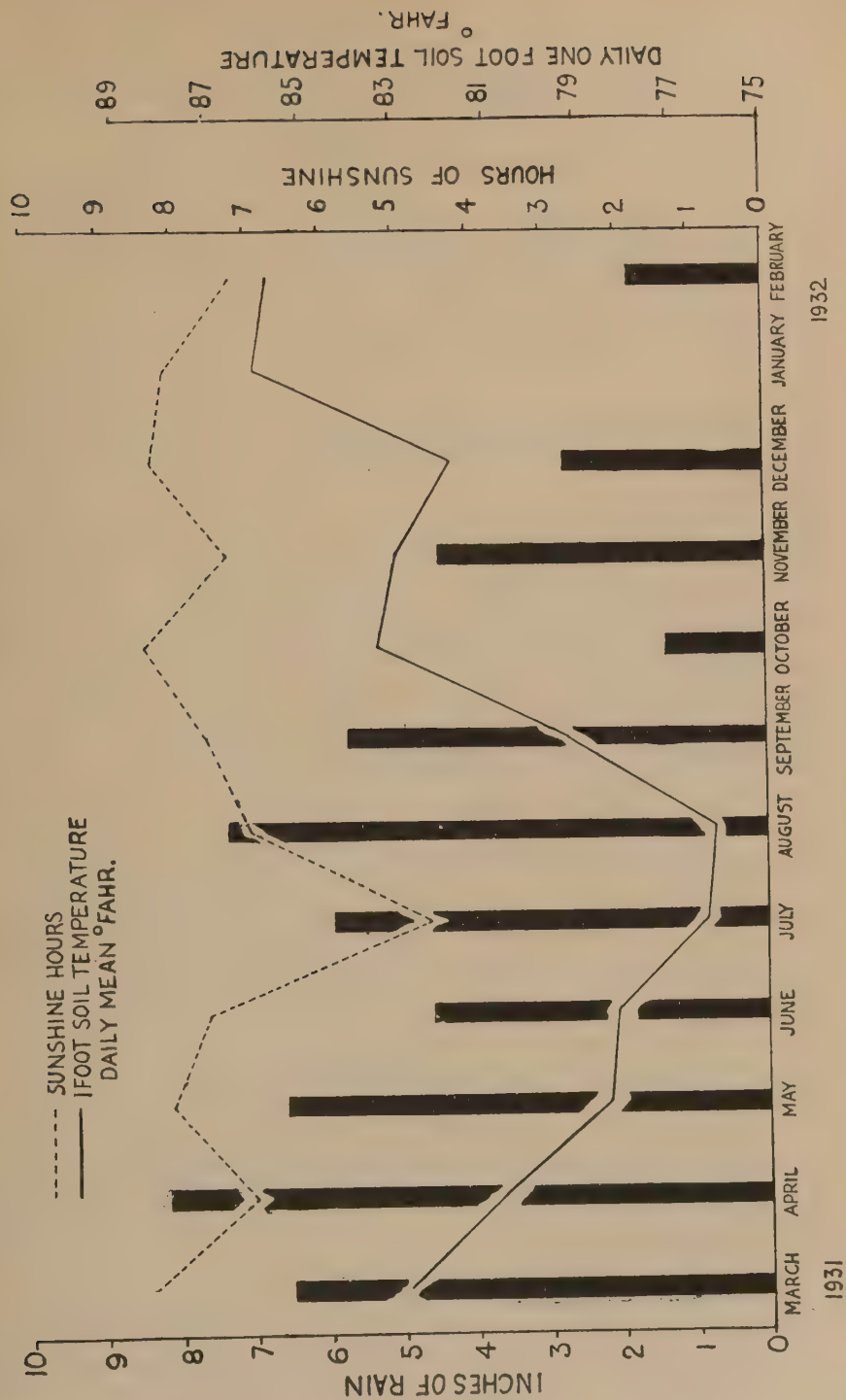
MONTHLY RAINFALL SUNSHINE & SOIL TEMPERATURES



SERERE RAINFALL 1931-32 2-DAY TOTALS



SERERE 1931-32 MONTHLY RAINFALL, SUNSHINE & SOIL TEMPERATURES



NYASALAND

REPORT ON THE WORK OF THE COTTON EXPERIMENT STATIONS, SEASON 1931-32.

INTRODUCTORY NOTE AND SUMMARY.

BY

H. C. DUCKER.

The following reports cover the season 1931/32 and to a lesser extent work done in 1930/31. The last previous full report was sent home in 1930.

During 1932 the final decision was taken to concentrate plant breeding and experiment work under the direct control of the Corporation's officers in the Domira Bay area, and the new station is given precedence in this report. Port Herald was finally handed over to the Department of Agriculture on January 1st, 1932, and has become a Government District Station. Makwapala, which has been shown to possess certain highly specialised features making it unsuitable as a cotton-breeding station for general purposes is also to become a district station, and will be handed over to Government after the 1933/34 season.

The Domira Bay station is admirably situated from nearly every point of view. It is close to railhead on the new railway now under construction, and to what is to be the main port of call for the Lake Nyasa steamers. It is approximately half way between Port Herald and Karenga, the most widely separated of the Nyasaland cotton areas, and, to the west, the rich plateau areas of central Angoniland are within easy reach of the Station.

Conditions on the station itself are those of summer crop cotton, sown early in the rains; but, within a distance of ten to twelve miles only, are areas where cotton may be sown in the middle of the rains, as a semi-summer crop, and after the end of the rains as a winter crop. The immediate neighbourhood of the station, in addition to providing conditions for experimental work, the results from which may be applied to the whole country, is also admirably adapted to development as a seed multiplication area.

Work at Domira Bay has so far consisted mainly in clearing and equipping the new station, and collecting various seed stocks from the older stations. A beginning has, however, been made in strain testing

and variety trials, and a crossing programme is now under way. In addition to the local seed stocks the Station is indebted to Mr. Parnell for a collection of the U.4 types bred at Barberton, and to Dr. Harland for some interesting cottons bred at the Corporation's Research Station in Trinidad.

Work at Makwapala has continued on lines described in previous reports. The yields of cotton obtained in 1932 are noteworthy as being the highest that have so far been recorded from this station.

It has been shown definitely that on the Makwapala type of soil cotton must be sown as an early summer crop, even a strain as adaptable in its requirements as U.4.

Strain tests with U.4 have proved somewhat inconclusive, but it has been possible to eliminate one of the several strains tried, on the ground of insufficient resistance to jassid attack.

Following the success obtained in controlling soil erosion, it seems probable that equal success will be obtained in supplying the second major requirement of the Makwapala soil, namely an easily assimilable organic manure. Results so far are most promising and the method that is being developed is easily applicable by natives in their villages.

Port Herald has been unfortunate in its first year as a district station in receiving another rainfall on the short side for the sandy alluvium of which the soil on the station is typical. Cotton yields are therefore rather low for the third year in succession. Having regard to the fact that the rainfall distribution was better in this past season, it seems probable that the low yield was due to soil conditions and not to the variety sown. At Maperera in the Chikwawa district a strain test similar to that at Port Herald gave yields in excess of 1,000 lbs. seed cotton per acre. The only real difference between the two sites was the heavier and more retentive soil at Maperera.

A beginning has been made with the study of the problems of mixed cropping at Port Herald. It is thought that this practice is preferable to rotation in certain circumstances.

In commercial cotton-growing the issues of the mixed bulk U.4. first made in 1930 are proving most successful, some high yields being reported, especially from the areas of heavier land in the Lower Shire. There is now enough bulk U.4 for the needs of the whole country, and the third wave of relatively pure seed from the stations goes into distribution this year.

While U.4 is proving very satisfactory as a high-yielding strain adapted to growth under varied conditions in Nyasaland, its lint quality is not too high, and market reports are that it is much harsher than the usual Nyasaland product.

It is to be hoped that the breeding work at Domira Bay will result in either an improved lint from a selection made in the U.4 types, or from a derivative from the crosses that are being made with other cottons.

As an example of the high yielding power of U.4 and its adaptability, it is of interest to note that an observation plot sown at Karonga in 1931 has given the highest yield yet recorded in Nyasaland, the plot in question giving 1,812 lbs. seed cotton per acre.

Staff.—Mr. Hoyle was in charge of the work at Domira Bay for the whole of the period under review; Mr. Miller was similarly in charge at Makwapala. During the absence on leave of the Cotton Specialist, Mr. Miller acted for this officer in addition to his other duties.

Mr. E. Lawrence, now Government Agricultural Officer, Lower Shire, was in charge at Port Herald up to June, 1932. He then proceeded on leave and his work was taken over by Mr. F. Barker, Government Agricultural Officer, Karonga, who was transferred for this purpose.

By courtesy of the Department of Agriculture a report by Mr. Barker on the work at Port Herald is included in this report.

DOMIRA BAY EXPERIMENT STATION, REPORT FOR THE SEASON 1931/32.

BY

S. T. HOYLE.

GENERAL.

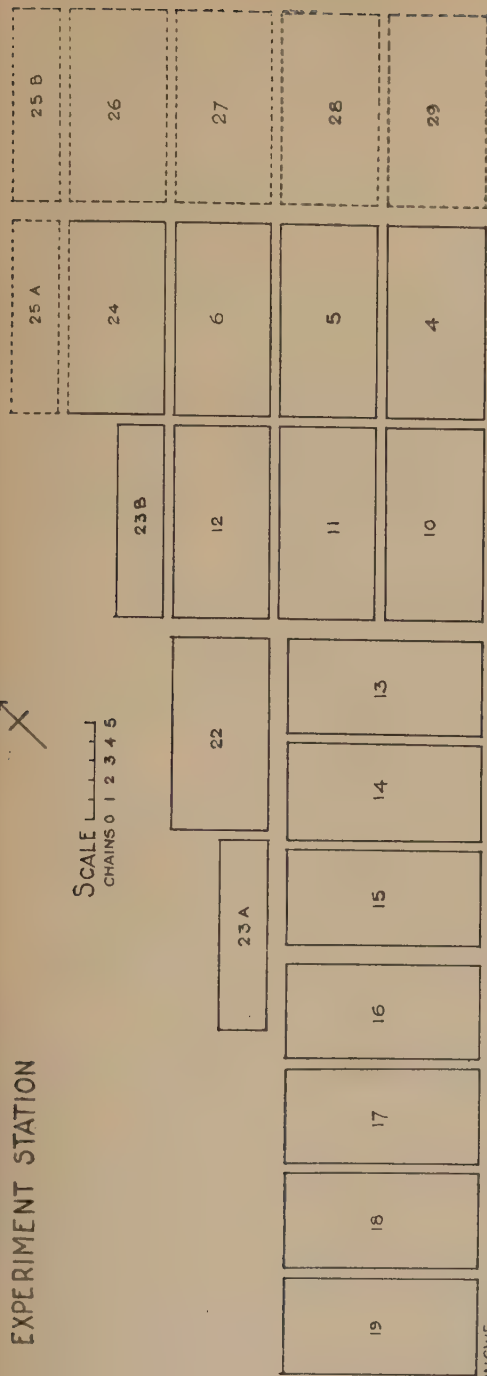
During the past season the dwelling house, general utility store and maize granary were completed. As can be seen from the photograph reproduced at the end of this report, the house is a two storied building, well suited to the climatic conditions of the lake flats on which the station is situated. The house has been mosquito-proofed. The new store consists of a carpenter's shop and a ginning shed at either end with an open central section for storage of farm materials. The maize granary consists of four cylindrical containers each holding about five tons of shelled grain. These can be made air-tight so that the maize may be protected from damage by use of an insecticide.

An additional thirty acres were cleared this year, bringing the total to one hundred and twenty acres of cultivated land. It is proposed to clear a further thirty acres in the coming season. A sketch plan (Fig. 1) is appended showing the layout. Each of the fields, with two exceptions, consists of a five-acre block 220 yards by 110 yards. This is a convenient size for general working, and, as the standard

DOMIRA BAY EXPERIMENT STATION



SCALE
CHAINS 0 1 2 3 4 5



TO DOMIRA BAY →

○ ○
○ ○
○ ○ LABOUR
○ ○ LINES
○ ○
○ ○

STORES
AND
WORK-SHOPS

FIELDS 1-3, 7-9 CLEARED 1929
" 4-6, 10-12 " 1930
" 13-18 " 1931
" 19-24 " 1932
" 25-30 TO BE CLEARED.

FIG. 1.

spacing between rows is one yard, the fields can readily be divided into one acre or smaller plots.

The two exceptions are fields which have been necessarily divided into two-and-a-half-acre blocks, 220 yards by 55 yards, owing to the proximity of gulleys or depressions. The main road from Lilongwe to Domira Bay runs through the centre of the Station and is nearly on a ridge line. The ground slopes from the Lilongwe end to the Domira Bay end, also away from the road on either side, the greatest falls over most of the cultivated area being approximately 1 in 100.

A comprehensive system of storm drainage has been carried out during the season, a total of four and a half miles of drains having been dug. Owing to the low mean fall it is thought that contour drainage will be unnecessary from the point of view of soil erosion, though it may be carried out later for purposes of water conservation. The drains have been dug along the field roads and it is unlikely that there will be any trouble from scouring. A most important point of the drainage system is that it will prevent a recurrence of the trouble experienced in the previous season when there were heavy falls of rain and considerable areas were water-logged, greatly restricting the growth of the plants. It should lead to better tilth, increased permeability of the soil and better root development of the plant, with its corollary of increased yield of cotton.

The proposed cropping scheme is two years of cotton followed by three years under Pigeon Pea. In the first of these three years the fields will be sown with maize, and undersown with pigeon pea, the latter then being ratooned for two years. A modification of this which will be begun this year is that in the first year following cotton some of the fields will be planted with leguminous food crops and planted in the following year with pigeon pea, which will then be ratooned for one year only. When the scheme is fully under way, in any one year there will be 60 acres of cotton, 20 acres of maize undersown with pigeon pea, 10 acres of beans, 30 acres of first ratoon and 30 acres of second ratoon pigeon pea. The area of cotton which is not wanted for breeding, trials or increase plots will be sown with improved bulk, the seed from which will be issued in the Lisungwe or other suitable area to provide seed stocks for general issue to the native producers. Approximately ten tons of seed can be expected each year from the bulk, which should be sufficient to plant up the Lisungwe area. The maize and beans will not only provide food for the labour during the wet season when local supplies are short, but will also pay for the hiring of temporary labour during the growing season when the pressure of work is greatest. The pigeon pea is a very inexpensive

crop, one annual cleaning being sufficient. Its main function is to improve the soil by reason of its deep rooting action and it is also a valuable food crop. Under this scheme it is hoped that the fertility of the soil will not become less but rather increase, and that the high yields of cotton which have been produced this year may be maintained or even exceeded.

SEASON.

The rainfall of last season, 1930/31, was abnormal, but in 1931/32 both the total fall and the distribution were better than usual. The total rainfall was eight inches greater than last year, but instead of over half falling in January the main rains were well distributed over December, January and February. The fields were never water-logged, and while there was no period when the plants suffered from water shortage, there were sufficient spells of dry weather to make the killing of grass and weeds a comparatively easy matter. Taken as a whole, the conditions were undoubtedly good, and this fact was reflected in the high yields of cotton obtained even on the first-year land and gives an indication of what this area is capable of producing when cultivation has proceeded a little further. The first rains fell on November 8th, a full three weeks earlier than usual. Ten days later there was enough rain for planting and five acres of maize were planted. As it turned out it would have been safe to plant up the whole station then, but as it seemed unlikely that further rains would follow immediately, the main planting was delayed until the second week in December. This interval was utilised in killing the first flush of weeds, an operation which usually cannot be done before planting, and greatly eased the pressure of work in December. From planting till well into March there were regular falls of rain and the cotton kept growing over the whole period without any setbacks. The rain at the end of April was quite exceptional and was not sufficient to produce another flush of flowers.

VARIETY AND TIME OF PLANTING EXPERIMENT.

This was planned on the lines of last year's experiment. The three varieties that have been grown on a large scale were used, namely U.4, Cambodia and Over-the-Top. The U.4 was seed taken from the local bulk. There were three times of planting, at intervals of three weeks, starting with the time of the main sowing on December 7th. The interval between the second and third sowing was rather more than three weeks because there were no suitable planting rains between January 18th and 22nd. The nine treatments were laid out in five randomised blocks, each plot being slightly less than a tenth of an acre.

The spacing was 3 feet by 2 feet, leaving four plants per hole. The results were as follows :—

TABLE I.
YIELDS IN LBS. SEED COTTON PER 1/10TH ACRE PLOT.
(MEANS OF FIVE PLOTS.)

<i>Planting Date.</i>	<i>U.4</i>	<i>Cambodia.</i>	<i>Over-the-Top.</i>
7th December	90.4	88.0	88.0
28th December	66.0	44.8	46.2
22nd January	9.2	6.0	8.0

The results were easily significant by Fisher's *z* test.

Standard error=10.95 lbs. or 22.1% of the mean.

Significant difference between means=17.8 lbs. ($P=.01$).

It will be seen that with all three varieties there is a significant difference between the first and second planting, and that the third planting produced very little cotton at all. A point to be noticed is that at the second planting U.4 gave a significantly higher yield than the second planting of the other two varieties, a further example of the capacity of U.4 to stand up to varied conditions. This was probably due in part to its earlier maturity, which is important in an area where the rainfall may be short in duration. It is not proposed to carry on with time-of-planting experiments next season as it is considered established that on the station itself the best results are obtained by planting as soon as possible after the first rains have fallen. The U.4 planted on 28th December gave a yield of 660 lbs. seed cotton per acre which shows that comparatively high yields may be expected even if the rains are two weeks later in arriving than the normal, which in this area is the second week in December. There is probably a critical date in January after which the yield is so small that it is not worth while to plant, but it is highly improbable that the rains will ever break as late as January.

SPACING.

No spacing trials have been completed up to the present. A series is being laid down for the 1932/33 season. As the native is the most important producer in this country the trials will be carried out on lines which are directly applicable to native practices. The present native method of sowing results in a haphazard arrangement of holes about three feet apart each way on the average, and with five to ten plants left per hole. Three feet being considered a suitable inter-row width for hand cultivation, a scheme has been prepared with the inter-row distance constant and the spacing in the row and the number of plants per hole variable so as to give a range of plant density from 14,520 to 29,040 plants per acre.

STRAIN TRIAL.

Four strains of U.4 were included in this trial, namely, U.4/2, U.4/4/2, U.4 bulk (from Barberton) and U.4 bulk (local). The first three strains were imported direct from Barberton in 1930 and have been once grown on this station. The local bulk is derived from the original importation of U.4 and has suffered a certain amount of admixture with other varieties, notably Cambodia. The four strains were arranged in six randomised blocks and planted on December 14th. The spacing was 3 feet by 2 feet, leaving four plants per hole. Each plot was 0.18 acres, which is large, but was chosen in an attempt to eliminate some of the minor soil differences which are very great after only one previous crop. The attempt proved abortive, as the high standard error shows, but this was partly due to the inequalities in the amounts eaten by buck. The standard error is nearly as high as in the time-of-planting experiment, where the plots were half this size, and in all trials next year small plots will be used laid out in a Latin square. When the land has been completely stumped and fallowed for three years under pigeon pea it should be much more even, but until that time high standard errors must be expected.

The results of the strain test are as follows:—

TABLE II.

	<i>Mean yield lbs. seed cotton/plot.</i>	<i>Equivalent yield lbs. lint/acre.</i>
U.4/2 	195	381
U.4/4/2 	196	392
U.4 bulk (Barberton) 	157	306
U.4 bulk (local) 	155	303

$z = .63$. 5% value of $z = .595$

Standard error = 30.5 lbs or 17.4% of the mean.

Significant difference ($P = .05$) = 37.5 lbs.

It will thus be seen that both U.4/2 and U.4/4/2 are significantly higher yielders than either of the two bulks, while there is no difference between them or between the two bulks. This next year the local bulk is being discarded and the other three strains, together with eight other substrains of U.4, will be put into two strain tests.

BULK.

The six fields of five acres each which were cleared last year were sown to bulk strains of U.4 and the average yield over the thirty acres was 258 lbs. lint per acre. Twenty acres were sown with U.4/2, five with U.4/4/2, and five with U.4 bulk from Barberton. The last named considerably reduced the average yield, as the yield for this field was

only 186 lbs. lint per acre. This small yield was probably due more to the soil conditions than to the seed. The field was the last to be cleared and as there was a progressive falling off in yield from the first to the last field to be cleared it is thought that this accounts to a large degree for the drop in yield. The highest yield was 289 lbs. lint per acre from a field of U.4/2. These yields are very satisfactory when the fact that the land was new and the poor standard of cultivation are taken into account. It must also be remembered that the fields contained all the stumps of the trees cut down and a number of termitaria which combine to reduce the effective area of cultivation considerably. No cattle can yet be kept on the station and no ploughs are in use; nothing was done therefore beyond digging with the native hoe, which does little except scratch the surface of the ground. The cultivation was no better than that which the ordinary native can give to his garden. The high yields can only be attributed to the fertility of the soil and the excellent climatic conditions for growing cotton in the Lake shore belt.

When the seed was planted the land was in a very rough state, being full of old grass roots and very lumpy. Immediately the first rains fell the land went into a good tilth and no trouble was experienced in getting a stand. There was not much seed available for planting and a rather low seed rate had to be adopted. The spacing employed was 3' by 2', five or six seeds being planted and thinned to four plants. The stand was nearly a full one and very little supplying was necessary.

Picking was done in one operation, with the exception of two fields which gave a light second picking. The grade of the cotton was remarkably good, approximately ninety per cent. being clean and white. Owing to the present low prices it was not thought worth while to grade the bulk, and the seed cotton was handed over ungraded to the British Cotton Growing Association for ginning. The Department of Agriculture will take over this seed for issue to native growers.

A five acre field of second-year land was planted with the local mixed bulk, but as this contained a certain amount of Cambodia mixed with it only one early picking was taken which yielded 248 lbs lint per acre. There would have been quite a large second picking, but as this contained a higher percentage of the later maturing Cambodia it was destroyed and only the first picking sent down country for the seed to be issued to the native growers.

One field was planted with Cambodia and Over-the-Top, two and a half acres of each. The yields were 161 and 232 lbs. lint per acre respectively. As these two varieties are not going to be grown in bulk

in the future, only one early picking was taken ; this was ginned on the station and the lint is being disposed of locally. The Cambodia especially would have given a good second picking. Some idea of the possible yield with these two varieties can be got from the variety and time-of-planting experiment. In this experiment the yields were approximately 290 lbs. lint per acre each. Next year these two varieties will be confined to the breeding block, as, though they are capable of yielding nearly as well as U.4, their characters are not so desirable.

BREEDING BLOCK.

The land chosen for the breeding block was the field which had given the highest yield of bulk cotton in the previous season. Unfortunately it proved to be more patchy than was thought at first, with the consequence that some of the strains were grown on poor soil and unable to do themselves full justice. Rows of stand-over cotton were left on the field margins in order to provide an early breeding ground for jassid and other pests. These rows and the jassid-susceptible varieties grown in the breeding block were effective in producing an early generation of jassid, so that all the strains were thoroughly tested for jassid-resistance.

The strains grown were selections made at Makwapala from the original bulk of U.4 together with some re-selections sent from Barberton in 1930. The most promising of the local selections have been numbered U.4 Nyasa 1, 2, . . . *et seq.*, and are being grown on in 1932/33.

The method of examination adopted was to take ten bolls from each of fifty plants (in some cases from 25 only), and to work out the halo length, boll weight, etc., on each individual plant. The best plants of each strain will be grown as progeny rows in the coming season. In the descriptions which follow the figures are the means of 50 plants, but as means are apt to be misleading, some frequency diagrams are also given (Figs. 2 and 3).

The characters measured are set out in tabular form after the description of the several strains.

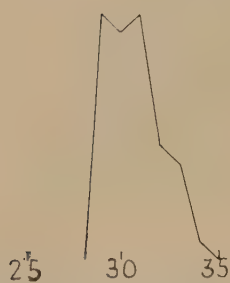
U.4 N.1.—This was a progeny row grown from a selection made last year. Fairly early and prolific with bolls on the small side ; open habit. The lint has the most silky appearance of all the U.4 selections.

U.4 N.2.—Another progeny row from last year's selection. Jassid-resistance is only moderate, but it is earlier than most : the bolls open very fully when ripe. The lint is shorter and the lint index higher than usual.

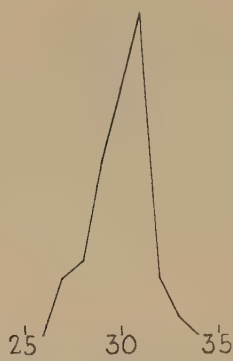
U.4 N.3.—This is an attractive selection which did well under rather poor soil conditions. It is early, with a dwarf upright habit and appears to be cropping heavily. The seed weight is satisfactorily high.

FIG 2

HALO LINT LENGTHS (M M)



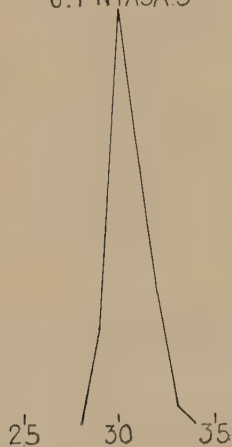
U.4 NYASA 3



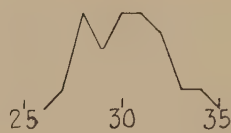
U.4 NYASA 4



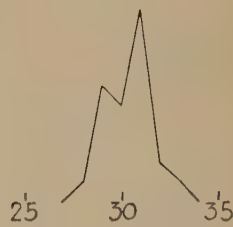
U.4 NYASA 6.



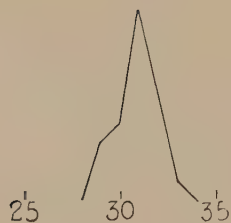
U.4 NYASA 7



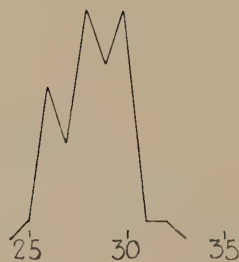
U.4 NYASA 9.



U.4.2.(920)



U.4.2.(955)



U.4 2 BULK.



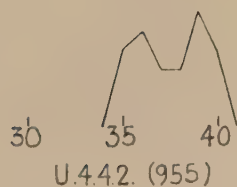
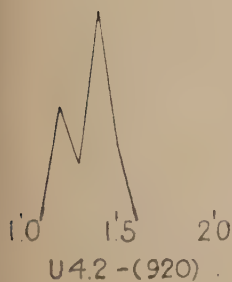
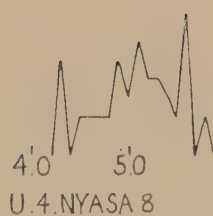
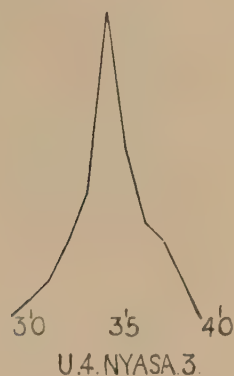
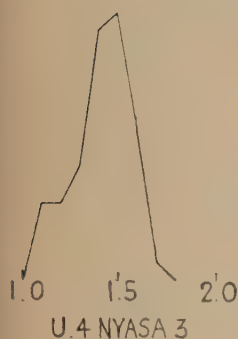
U.4 BULK

FIG 3

WEIGHT OF LINT
PER BOLL (GRS)

LINT INDEX
LINT PER 100 SEEDS (GRS)

GINNING OUT-TURN
LINT PER CENT SEED COTTON



U.4 N.4.—A tall open type which cropped satisfactorily. The bolls are quite storm proof.

U.4 N.5.—This is a dwarf early type with high jassid-resistance. It showed up strikingly in an observation bulk. Unfortunately some of the measurable characters are not as high as could be desired.

U.4 N.6.—Another attractive selection of good habit. It is highly jassid-resistant, with leaves of very dark green. It is reminiscent of Andrews 12, and may possibly be a natural cross. It has the largest bolls of the U.4 strains and a high lint index.

U.4 N.7.—A short, compact type of plant which has done well this past season; good jassid-resistance; rather small bolls.

U.4 N.8.—This was rather mixed in the field, but the plants were generally of a tall, open type, rather late in ripening. The seed weight and lint index are exceptionally high.

U.4 N.9 (U.4/5/1).—This and U.4 N.10 (U.4/5/5) were not grown at Domira Bay this year and the seed cotton was sent up from Makwapala for investigation.

<i>Strain.</i>	<i>Halo length. mms.</i>	<i>Wt. of lint per boll. gms.</i>	<i>Wt. of 100 seeds. gms.</i>	<i>Lint index.</i>	<i>Ginning out-turn.</i>
U.4 N.1 ...	31	1.4	7.8	4.5	36.5%
U.4 N.2 ...	29	1.4	8.8	4.8	35.4%
U.4 N.3 ...	31	1.4	9.0	4.7	34.3%
U.4 N.4 ...	30	1.4	7.9	4.6	35.1%
U.4 N.5 ...	30	1.2	7.4	4.1	35.9%
U.4 N.6 ...	31	1.7	8.7	4.8	35.0%
U.4 N.7 ...	31	1.3	8.6	4.5	36.3%
U.4 N.8 ...	30	1.6	9.6	5.1	34.6%
U.4 N.9 (U.4/5/1)	30	1.6	9.0	5.1	36.0%
U.4 N.10 (U.4/5/5)	30	1.7	8.9	5.1	36.1%

SELECTIONS SENT FROM BARBERTON.

U.4 C. 28.—A compact cotton on the late side, but with very little vegetative growth. Highly jassid-resistant and has cropped well.

U.4 Z.14.—The jassid-resistance is good and the plants have grown well; appears to be a good cropper.

U.4/2 (920).—Grown as single plants this selection does not appear to be better than the bulk U.4/2 which has done well in the past two seasons.

U.4/4/2 (955).—A very small and compact type of plant, producing a large number of bolls. A promising selection.

<i>Strain.</i>	<i>Halo length. mms.</i>	<i>Wt. of lint per boll. gms.</i>	<i>Wt. of 100 seeds. gms.</i>	<i>Lint index.</i>	<i>Ginning out-turn.</i>
U. C.28 ...	31	1.5	8.9	4.9	35.6%
U.4 Z.14 ...	30	1.4	7.8	4.6	35.8%
U.4/2 (920) ...	30	1.5	8.0	4.5	36.0%
U.4/4/2 (955)	31	1.5	8.5	5.1	37.6%
U.4/2 bulk ...	28	1.3	7.8	4.3	35.6%
U.4/4/2 bulk...	29	1.4	8.3	4.9	37.1%
U.4 bulk (Barberton)	29	1.4	8.0	4.5	36.1%

CROSSES.

In order to widen the basis of selection in U.4, some crossing has been done with other varieties. This was begun in the 1930/31 season and was carried on again last season. The greatest number of crosses have been made with Cambodia (G.C. 664/1). In 1930/31 Cambodia was crossed with all the U.4 types previously selected at Makwapala; the cross was made both ways. In this way it was hoped to get as large a variety of U.4 genes as possible. This year the resulting F.1 has been backcrossed with U.4/2 and the seed so crossed will be sown as a bulk for mass selection next year. Over-the-Top (B.30/1) was also used as a parent and the procedure was the same as in the case of Cambodia.

In 1930 Dr. Harland sent a number of varieties from the Corporation's Research Station, Trinidad, for trial in this country. All of them were jassid-susceptible to a greater or less extent; some were obviously unsuited to the climatic conditions, but there were others which it was thought worth while to cross with U.4. In the description which follows the numbering is Dr. Harland's.

A number of Moco types were grown, but failed to set any seed, all the flowers being shed. Three Upland types from Brazil (Nos. 29, 99 and 105) had rather short lint, but the general growth was sufficiently good to warrant crossing with U.4. The same applies to Delta Webber. A cross between Texas green lint, Guatemala khaki and Triumph was only slightly susceptible to jassid and the general growth was excellent; it is hoped that something useful may come out of the cross when the khaki lint and other undesirable characters have been eliminated. All last year's F.1's have been backcrossed with U.4 and selection will be begun next year.

In 1931 Dr. Harland sent a cross $(2 \times 34) \times 57$ which was grown as an observation bulk. Most of the plants were completely jassid-susceptible, failing to set any seed at all, and the effect of the bombardment on neighbouring U.4 plants was very obvious. One plant however, was outstanding and set a number of bolls, which speaks well for its jassid-resistance as it was growing in the middle of this otherwise jassid-susceptible cross and so must have suffered a very severe bombardment. The characters of this plant are worth noting, for though the lint was rather short, the other measurements, especially the boll size, were exceptionally large. The characters were as follows:—

<i>Halo length.</i>	<i>Wt. of lint per boll.</i>	<i>Wt. of 100 seeds.</i>	<i>Lint index.</i>	<i>Ginning out-turn.</i>
27 mm.	3.2 grs.	11.7 grs.	6.8	36.8%

PESTS.

All the more common pests of cotton were found last season, but they were never present in sufficient numbers to cause any serious damage. The natural control provided by the early onset of the dry weather in this area appears to be effective in keeping down their activity to negligible proportions.

Bollworm.—Bi-weekly counts of the bollworms and damaged bolls and squares were made on a hundred plants in the bulk U.4. By far the commonest was the Red bollworm which was found in fairly constant quantity from February to the middle of April, after which date the number fell off rapidly. Only a small number of American and Spiny bollworms were recorded. The number of squares and bolls damaged by bollworm was always greater than sheddings from physiological causes and was fairly constant from February till the end of June when the cotton was harvested.

Stainer.—This was present in sufficient quantity to cause a bad attack of internal boll disease, but, whether on account of the dry weather, as stated above, or from some other cause, the amount of stained cotton was negligible.

Jassid.—This was present during the whole of the season, having got an early start from the stand-over rows of cotton, but there was no apparent damage to the U.4.

OTHER CROPS.

Maize.—Last season was the first year that maize has been grown on the station. The original clearing of thirty acres, after two crops of cotton, was sown with maize, with the exception of three half-acre plots which were sown with varieties of sorghum, and the whole under-planted with pigeon pea. Two varieties of maize were sown, Potchefstroom Pearl and a yellow drought-resistant variety from Honduras. All the yield figures given below are for shelled maize. At the time of writing it has not been possible to finish the shelling of the yellow maize and so no figures are available for that variety.

Three five-acre fields of Potchefstroom Pearl were sown, one being planted on November 23rd and the other two on December 10th. The first date is two to three weeks earlier than usual, but it did not appear to give any increased yield. The yields were:—November planting 3,220 lbs., December plantings 3,320 and 3,215 lbs. per acre respectively.

The first field of the December planting was laid out as a spacing experiment. The rows were all three feet apart and three different

arrangements within the rows were tried: (1) Two plants per hole 2' apart; (2) One plant per hole 3' apart; (3) Native spacing, which is approximately 3' apart and up to six plants left per hole.

The results were as follows:—

<i>Treatment.</i>	<i>Mean Yield lbs. per plot.</i>	<i>Equivalent yield lbs./acre.</i>
1	650	3610
2	517	2880
3	627	3480

$z = .755$ 1% value of $z = .758$.

Standard error of one plot = 46.8 lbs or 7.7% of the mean.

Significant difference between means ($P = .01$) = 80 lbs.

The second spacing is, therefore, significantly worse than the other two. The native spacing has a bigger density of plants per acre, and a large number of undersized cobs are produced, but the final yield is the same as that of the more regular spacing of two feet with two plants per hole.

The yellow Honduras maize has a very small cob, a number of which are produced on each stem. At present it is very mixed, but in general it is a hard variety and the cob well protected, so that it is particularly well suited for native growing as it will keep well in the open stores used by the native.

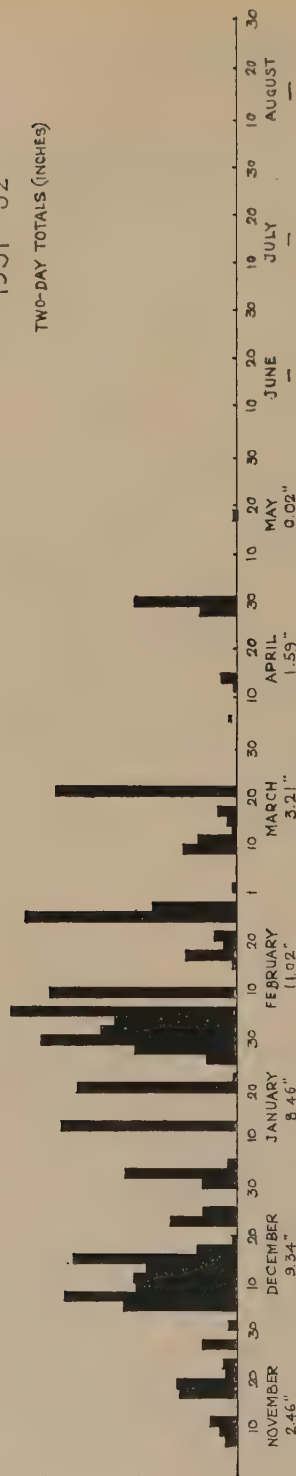
It is interesting to note that the local native was much impressed by the growth of both these varieties on the station, and there is a big demand for seed.

Sorghum.—Three varieties of sorghum were obtained from Port Herald and half an acre of each was planted. These all yielded rather more than 2,500 lbs. seed per acre. Aphis and stem borer were present, but did not do enough damage to reduce the yield appreciably. Most of this seed will be issued to native growers in return for their seed which will be used as food for the labour force.

Beans.—Tepary, Green Gram and Bush Lima beans were planted, the first of these yielding particularly well. Only a small plot of Green Gram was planted and it yielded at the rate of 1,150 lbs. per acre. The Bush Lima was interplanted between the rows of bulk cotton, but was completely overshadowed and resulted in a very small yield. The natives are keen on planting all three varieties, in fact some of the Tepary issued for food has already been sown in the wet 'dimba' land. The natives of the Lake shore belt have a poor selection of food crops at present and are keen to plant all the better varieties which have so far been grown on the station.

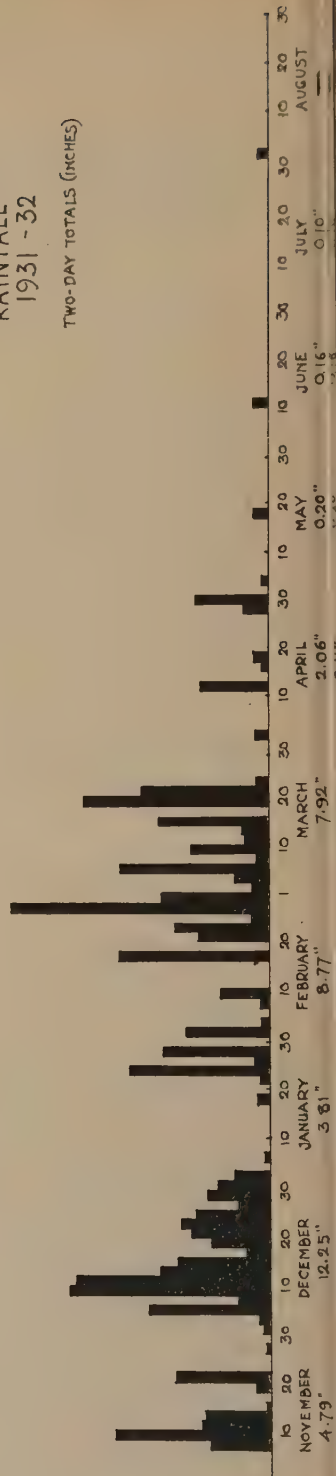
DOMIRA BAY RAINFALL 1931-32

TWO-DAY TOTALS (INCHES)



MAKWAPALA RAINFALL 1931-32

TWO-DAY TOTALS (INCHES)



NYASALAND (DOMIRA BAY)



3.—BULK U.4 SELECTION—YIELD NEARLY 300 LBS.
LINT PER ACRE. DOMIRA BAY.



4.—HOUSE AND GARAGE. DOMIRA BAY.



1.—PROGENY BLOCKS OF U.4 SELECTIONS—ROW ON
RIGHT OF A DWARF TYPE: TWO ROWS ON LEFT OF A
TALL TYPE. DOMIRA BAY.



2.—NEAR VIEW OF DWARF AND TALL TYPES SHOWN IN
FIG. 1. DOMIRA BAY.



MAKWAPALA EXPERIMENT STATION REPORT FOR THE SEASON, 1931/32.

BY
W. L. MILLER.

SEASON.

The effective rainfall during the past season, though nearly five inches in excess of that received in 1930/31, was exceedingly well distributed. There were no long periods of wet sunless weather, and conditions in general have been most favourable. A more complete contrast than the past two seasons can hardly be imagined, and the rainfall diagrams for the two years are well worth comparison.

Good early rains fell in November and totalled over four inches. These enabled a good tilth to be prepared, especially useful on the land which had been ploughed late and was lumpy, and rendered possible the destruction of the first flush of weeds before any planting was done.

December was the wettest month with 12.25 inches of rain (it may be noted that in 1930/31 January had this distinction), and though this rather complicated planting operations and caused some rotting of seed no real harm was done and final stands were good. In January a most welcome dry spell occurred, which, while not severe enough to interfere with growth, permitted thorough cultivation of the young crops and encouraged sound root development. It is this which forms the greatest contrast with the 1930/31 season when January conditions were bad throughout the month. Conditions through February continued good, rain and sun were well distributed, growth was satisfactory, and cotton flowering was well under way by the middle of the month. Two falls on successive days totalling nearly four inches of rain did surprisingly little damage. Some heavy falls of rain occurred in March, but the intervals were bright and dry. Rather more rain fell in this month and in April than was really desirable, and resulted in a moderate attack of internal boll disease on the cotton, but no severe check to growth as in the previous season was manifest and the final results were distinctly favourable.

The 1931/32 season, if not the best the station has experienced since its inception, was at least as good as the previous best season of 1926/27.

GENERAL.

The work of the Station has continued on the lines described in the 1929/30 report. Plant breeding work on cotton is now concentrated at the Domira Bay Station, and Makwapala is becoming more and more a district station devoted to the study of the specialised conditions of the area it represents.

The general lines on which the work of the station runs have remained unaltered, and attention continues to be specially directed to the problems presented by the lateritised loam soil. The results obtained during the past two seasons have confirmed previous ideas on the needs and limitations from a cotton standpoint of the area represented by the station.

Except for a small open garage, no additions have been made to the building accommodation on the Station. This small building was erected by Station labour from local materials and involved no special capital outlay, the cost being met from current votes. The original buildings of the Station have all been overhauled and put in good repair, the thatch of the dwelling houses, the tobacco bulk shed and implement store being replaced, and all pointing touched up where required.

Apart from an extension of the fire protected belt of forest land on the station boundary and a small area planted with *Eucalyptus citriodora*, no additions have been made to the areas devoted to re-forestation work. This work has made considerable progress and it is already possible to draw certain general conclusions from it which bear on the problems of shifting (Chena) cultivation.

The decision to concentrate the cotton breeding work at Domira Bay, together with the extension of the activities of the Department of Agriculture, have led to proposals being made by the Department to take over the Station, and the Corporation have agreed that this shall be done after the 1933/34 season. Port Herald has already been handed over to the Department and now functions as a District Station. The intention is that Makwapala shall be used similarly, and, in addition, serve as a training centre for Native agricultural instructors, a purpose for which it is well suited.

This will therefore be the last full report produced by Makwapala as a Corporation Station.

ROTATIONS.

Work on rotation cropping of the Station has continued on the lines described in previous reports. This work has now been carried on for eight full seasons, on the same lines. While none of the rotations in use can be claimed as ideal, from a combination of the cropping schemes a generalised recommendation can be prepared for a system of cropping, suited to the needs of the area, as being calculated both to maintain the fertility of the soil, and to provide sufficient foodstuffs for the labour and their dependants. In addition, provision can be made for the cultivation of a limited area of money crops, of which cotton may be one.

It must, however, be admitted that the experience gained on the Station indicates that for the specialised soil type which Makwapala represents a very considerable advance must be made in the agricultural education of the native. His methods, while containing many good points, are not calculated to provide for a continued production of food and money crops on the same land. As regards cotton, it may now be stated definitely that the Makwapala soil type is unsuited to the continued production of this crop under existing native methods. The rotation cropping work at Makwapala, in conjunction with the work done on anti-soil-erosion measures, and the local production of organic manure, has, however, indicated lines along which the native methods may be improved and cotton established as a stable crop.

The layout given in the 1929/30 report was modified in 1931 and in this past season by the incorporation in Rotation II of a bright tobacco break, catch-cropped with short term pulses. This replaces the ground-nut break. The latter was incorporated in a three-year rotation used in the miscellaneous cropping area of fields 4, 5 and 6, where a special study was made of the effect of intense cropping of long and short term pulses on the fertility of land showing marked lateritisation.

The development of the native dark tobacco industry, and the discovery that bright flue-cured tobacco needs specialised conditions, make it unlikely that the latter will form a really suitable rotation for cotton, which is now almost entirely a native crop. A reversion is accordingly being made for the 1932/33 season to the 1929/30 layout for Rotation II.

The cropping schemes for the two past seasons were as follows :—

SEASON 1930/31.

		Field.		Field.		Field.
Rotation I	...	Cotton...	10	Maize	...	9
				$\frac{1}{2}$ Sunn hemp		
				$\frac{1}{2}$ Jack bean		
„ II	...	Cotton...	11	Maize	...	8
„ III	...	Cotton...	12	Pigeon pea	...	7
„ IV Misc.	...	Pulses	6	Maize	...	4
				Bright tobacco		2
				Dark tobacco...		3
				Pigeon pea	...	5

SEASON 1931/32.

		Field.		Field.		Field.
Rotation I	...	Cotton...	9	Maize	...	1
				$\frac{1}{2}$ Sunn hemp		
				$\frac{1}{2}$ Jack bean		
„ II	...	Cotton...	8	Maize	...	2
„ III	...	Cotton...	7	Dark tobacco	12	
„ IV Misc.	...	Pulses	5	Maize	...	6
				Bright tobacco		10
				Pigeon pea	...	3
				Pigeon pea	...	4

In both years the Jack beans (*Canavalia sp.*) were badly attacked by a leaf-eating beetle, and had to be re-sown. Even the second

resowing in 1931/32 was a failure and the field had to be planted up with miscellaneous short-term pulses. This crop (Jack bean) gave promise, when first grown, of rivalling pigeon pea in its action by a powerful root system on the lateritised pan in the Makwapala soil. Its failure is therefore rather unfortunate, but is offset by the fact that the beans are not relished as a food by the natives. Its future was therefore in doubt even before this failure.

The maize sown is a strain of Potchefstroom Pearl originally imported direct from S. Africa. It has been mass selected at Makwapala over the past seven years and is now a hardy strain free from disease and yielding well. It is liked by the natives and is apparently in no way inferior to their own stock for food purposes. It is a small white "flat" maize and is suitable for the export trade.

The beans used as short-term pulse catch crops are with one exception (a red kidney type of *Phaseolus vulgaris* which is very well liked by the natives) all white varieties, these having the best chance of finding a market if and when an export trade can be developed. The following were sown and cropped successfully in the past two seasons: Tepary (*Phaseolus acutifolius*), Bush Lima (*Phaseolus lunatus*) and a white selection, made locally, of a kidney bean (*Phaseolus vulgaris*). Samples of the latter have been sent to England for comment and valuation. They are reported as suited to the Continental trade and to be worth £14 per ton as the market stood in May, 1932. It would appear that in this bean, as well as in the Bush Lima, another Makwapala production, has been found a valuable potential export crop which is suitable for rotation cropping with cotton. Both beans are well liked by the native and suited to a wide range of conditions in Nyasaland.

Pigeon pea has continued to prove a great success as a soil-renovating crop. It is popular with the native and has a good food value. The work cattle at Makwapala have been allowed to graze the first-year crop during the past two seasons. This is green and succulent, with a very fair setting of pods at a time when natural grazing is dry, of poor value, or even lacking altogether in some areas.

The pigeon pea has proved to be a satisfactory crop to interplant with both tobacco and maize, and ratoons satisfactorily for at least one year. Its effect on the soil is such that the maize in field 6, following this crop and sundry other pulses, has this past season given the best yields of any on the Station. Prior to this field being fallowed under pigeon pea, maize had been a failure there.

Cotton was grown for the first time following pigeon pea in field 7 in 1932 and yielded very well indeed. The growth and crop were fully as good as that obtained from green manured land in field 9, and it would

seem that in pigeon pea a crop may have been found which will take the place of green manuring in native agricultural practice. The importance of this is considerable since it means that instead of losing his land for a season and having to do some hard work in burying the green manure, the native can grow a crop which gives him some return for his endeavour at a minimum of trouble to himself. The labour involved in handling pigeon pea as a biennial is very small indeed.

Tobacco in 1931 suffered severely from the season, but in 1932 results were distinctly good. There is little doubt that as a rotation for cotton this crop has much to recommend it. With their contrasted root systems the benefit obtained from the rotation is mutual, and they interfere but little with each other in their labour requirements.

Western tobacco, as mentioned above, is the type best suited to native production and most likely to be used in rotation with cotton. Work at Makwapala with this crop has not only demonstrated its utility in this connection, but also indicated that selection work with it may be done with advantage on the Station. The soil conditions, provided fertility is maintained, are not so marked in their effect on this crop as on cotton.

COTTON EXPERIMENT WORK.

Work has been continued during the past two seasons on the U.4 variety, no other varieties having been planted.

As in previous years cotton has been treated as a rotation crop and all experiment work based on one or other of the three main rotations.

Fifteen acres of U.4 were grown each season. In 1932, in addition to the Makwapala bulk U.4, derived from the 1928/29 importation, three substrains were sown that were originally derived from this bulk and grown in multiplication plots at Port Herald in 1931; a sample of bulk seed twice grown at Domira Bay was also grown.

The yields of the increase plots sown in 1931/32 season were as follows :—

Field 9.N $\frac{1}{2}$	...	U.4/5/1	...	...	582 lbs. seed cotton per acre.
„ 9.S $\frac{1}{2}$	...	U.4/5/5	...	...	1,018 „ „ „ „ „
„ 8	...	U.4/5/12	...	...	771 „ „ „ „ „
„ 8	...	Domira Bay Bulk	...	...	715 „ „ „ „ „
„ 7	...	Makwapala Bulk	...	...	737 „ „ „ „ „

With the exception of U.4/5/12 there was but little between the various lots in general appearance. The strain named was definitely inferior in jassid-resistance to the remainder, and it is reported that this inferiority was even more marked at Port Herald.

The lower yield of U.4/5/1 is almost entirely due to the poverty of the half field on which it was grown. This half field has had no manure whatsoever since it was first cleared, and has not been cropped to a deep rooting pulse except in one year, 1928/29. The other half of field 9 was green manured in 1930, field 8 received a light dressing of farmyard manure the previous year, and field 7 had been fallowed under pigeon pea. Altogether this season's results are a pleasing confirmation of earlier ideas about the requirements of the Makwapala soil. There is no indication that cotton bred to suit the Domira Bay soil will not also suit Makwapala soil in good heart.

The percentage of stained cotton amounted to close on three times that recorded at Domira Bay on the bulk sowings and showed that even in this, a relatively good season for both areas, the later rains and higher humidity in April-May at Makwapala were a disadvantage where cotton is concerned.

The three substrains were by no means pure, and seed stocks of each, except U.4/5/12, have been sent to the breeding block at Domira Bay for further work. A further range of selections from the Makwapala bulk U.4 are also being sown at Domira Bay this coming season.

Continuous records.—Records were kept in 1931 of the time-of-planting trial, and in 1932 of sample rows in the mixed bulk. This was done to avoid interference with the growth of the 1932 time-of-planting plots by trampling. Flowering, shedding, and bolling were recorded, and the shedding loss analysed into that due to bollworm and to non-bollworm loss respectively (*See* Figures 4 to 6). The diagrams show the difference between the two seasons in the effect on early sown bulk cotton. This is specially marked in the flowering curves and shedding losses. There was a long flowering curve in 1932, while shedding losses rose to no particular peak. In 1931, however, the rapid decline in flowering coincides with the bollworm loss peak in March, and clearly demonstrates the severity of the American bollworm attack mentioned in last year's summary. All three of the common bollworms were present in both years, and the development of the American bollworm attack appears to have been the most marked difference between the two years. This appears to be directly correlated with the climatic conditions and the resultant difference in growth.

The time-of-planting records agree completely with the yield figures, and the 1931 results are confirmed by those of 1932.

There is no doubt whatever that, with the soil conditions of Makwapala, early planting is absolutely essential if cotton is to be a success.

SOWING DATE 12 12 30

FIG. 4.

3.

2.

1.

SHEDDINGS PER HOLE PER DAY

FLOWERS PER HOLE PER DAY

BOLLS PER HOLE PER DAY

BOLLS

FLOWERS * * * * * BOLLS
BOLLWORM — — — — —
SHEDDINGS { NON BOLLWORM ○ ○ ○ ○ ○

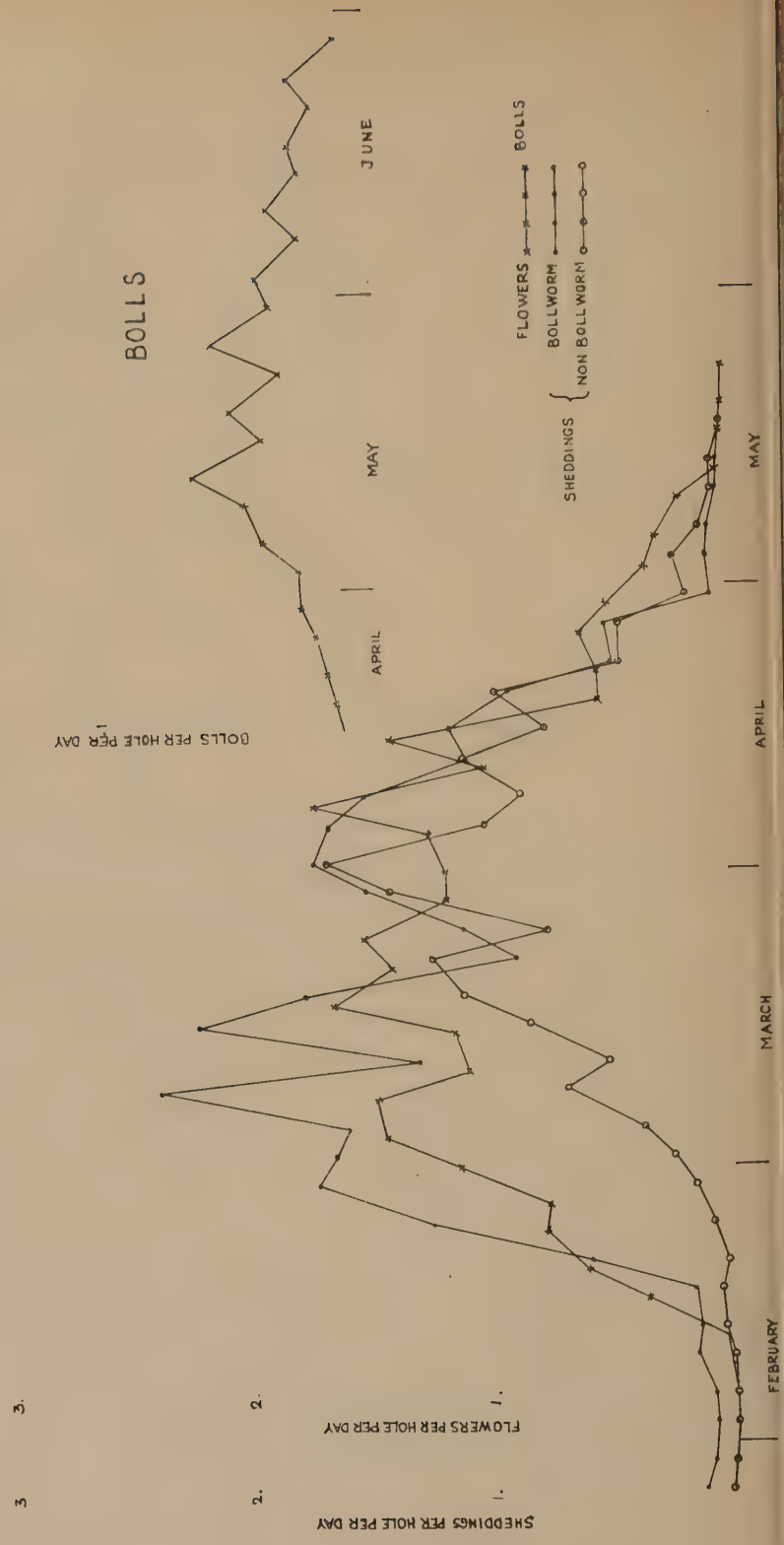


MAKWAPALA
1931-32

PLANT RECORDS
BULK U4

SOWING DATE 7 12 31

FIG. 5.



TIME OF PLANTING TRIAL

MAKWAPALA
1930-31

FIG. 6.



Field trials.—Spacing, time-of-planting, and strain tests were carried out in 1932. Randomised block layouts were used, fitted between ridge terraces in each case, the plots running immediately up and down hill. Five replications were used in each case. As will be seen, except in the case of the large differences obtained in the time-of-planting experiment, this number of replicates was probably on the small side. The bulk seed used was that obtained from Domira Bay.

Results were obtained as follows :—

1/40th acre plots were used throughout the experiments. Yields are given in lbs.

SPACING EXPERIMENT.

Variants	4'×2'	4'×18"	4'×12"	3'×3'	3'×2'	3'×1'
Mean Yield/plot	28.5	27.4	26.3	26.2	30.9	27.1
Equivalent Yield per acre ...	1140	1096	1052	1048	1236	1084

$z = .5920$. 1% point value of $z = .7058$. 5% value of $z = .4986$.
Significant difference between two plot means = 3.9 lbs.

The differences here are interesting in that they do not seem to confirm previous experiments. So far a direct correlation has been found between plant density and yield at normal inter-row spacings such as the above. It is of interest to note that the highest yielding plot, that at 3' × 2', is at the spacing used as standard at present at Domira Bay. The significance of the whole experiment is not very high however, as the figures for the z test show.

TIME OF PLANTING EXPERIMENT.

Variants. Date of sowing	December 7th	December 17th	December 27th	January 6th
Mean Yield/plot (lbs.) ...	26.7	15.3	12.9	6.5
Equivalent Yield per acre	1068	612	516	260

Significant difference between two plot means = 4.4 lbs.

The value of z easily exceeds the 1% point and the results are highly significant. December 17th is not significantly greater than December 27th, otherwise the yield from each planting is significantly greater than that following.

STRAIN TEST.

Variants	U.4/5/1.	U.4/5/5.	U.4/5/12.	U.4 Bulk.
Mean Yield/plot (lbs.) ...	25.4	28.5	22.2	23.9
Equivalent Yield per acre	1016	1140	888	956

$z = .6391$. 1% point value of $z = .8919$. 5% value of $z = .6250$.

The significance of the experiment is low and the results are not too reliable.

It is noteworthy however that U.4/5/12, which was noted both at Port Herald and at Makwapala as being distinctly more susceptible to jassid, is bottom of the list.

The spacing trial is being revised this coming season and a range of spacings will be tried which it is hoped will give some decisive results. These spacings are considered suitable for native practice. The time-of-planting experiments are regarded as proving conclusively the need for early sowing at Makwapala, and that the latter is essentially a summer crop station. They will not be repeated.

The strain test is being repeated this coming season. In addition to the two strains 5/5 and 5/1 which are both being retained, certain of the lots grown at Domira Bay in 1932 will also be tried.

Farmyard manure.—It has been clearly shown during the past three seasons that the main requirement of the Makwapala soil, following on anti-soil-erosion measures, is a supply of organic manure.

In 1930/31 the first applications were made of manure as prepared in the covered yards built in 1929/30. These did a certain amount of good, especially in the matter of improving the tilth of the lands, but there were indications that the manure made was insufficiently decomposed. The Western dark tobacco in particular suffered from what appeared to be nitrogen starvation, following on denitrification due to the delayed decomposition of the manure in the soil.

The book by Howard and Wad, dealing with the methods of manufacturing organic manure in use at Indore, was obtained in December 1931, and it soon became obvious that the methods which had been in use at Makwapala, in the manufacture and storage of the manure in covered yards, were wasteful and inefficient. It appeared further that insufficient care had been taken in the mixing of the ingredients from which the manure was derived.

After careful consideration of the methods used by Howard, and the principles involved, it was decided that a modification of the covered yard method of manufacture, combined with fermentation under reasonably controlled conditions in pits, might prove practicable. The aim was not necessarily to produce the highest quality of manure with the least loss of nitrogen and other valuable ingredients, but to evolve a technique which should produce a reasonably good grade of manure and be applicable by natives in their kraals.

As before, the first stage in the manufacture of the manure, as carried out this past season, takes place in the covered yards, where the organic matter receives an adequate amount of dung and urine. The organic matter put into the kraal, however, instead of consisting merely of a random mixture of maize stover, dry sunn hemp stalks,

and similar waste, consists of as large a range of ingredients as possible. An important source of organic matter is weed and grass growth from waste land, cut and carted in the green state ; this green material is wilted, and thoroughly mixed with the other forms of readily available organic waste before being put into the yards.

Instead of the accumulation in the yards being allowed to remain, the yards are cleared at short intervals and heaps of manure compost are made up of the mixture in pits which have been dug adjacent to the buildings.

Turning and watering of the heaps is done much as recommended by Howard, the main guides to the necessity for this being the heating of the heaps and development of fungal growth. As soon as the heaps commence to cool and fungal development to slow down they are turned. The process is continued until satisfactory rotting has taken place, when the manure is ready to go out to the lands.

So far, the results obtained appear satisfactory. Instead of a partially broken down and insufficiently rotted mass, the compost prepared this season resembles a dark mould, clean smelling, and reduced to fine proportions. It has been found that very little extra labour is involved in the preparation of this manure, most of the work being done by the cattle boys in slack periods for field work.

Some eighty tons of the new form of compost have been made and applied to the land this dry season. Next year its effects will be seen. If they prove as satisfactory as is hoped a large step forward will have been made in the improvement of the agricultural methods suited to the native cotton producer of this country.

PORT HERALD STATION, REPORT FOR SEASON 1931/32.

BY

F. BARKER.

Following upon the closing down of the Government experimental Station at Nyachipere, Port Herald, in 1922, the present experimental Station was opened by the Corporation in 1925, and until 1929 it was maintained and developed by the Corporation under the charge of one of their own officers. During the period 1930/31 the Station was in the charge of the District Agricultural Officer, Lower Shire District, who undertook its superintendence on behalf of the Corporation in addition to his district agricultural duties. From January 1932, the station was taken over entirely by the Department of

Agriculture, who extended it so as to include work on native food crops, oil seeds, pulses, cotton, etc., under summer, semi-summer, and winter conditions of cropping. Work in connection with cotton will continue in close collaboration with the Cotton Specialist and in the main the various cotton experiments will be so designed as to link up with the experiments at the new station at Domira Bay.

SEASON.

The table of seasonal rainfalls below enables comparison to be made between the season now ending and the two immediately preceding it. From the figures for 1931/32 it will be seen that the cotton crop was favoured with a well distributed rainfall, especially as compared with 1930-31. For all three seasons however, the total rainfall was inadequate on the light sandy alluvium of the Station. To build up an adequate supply of subsoil moisture in this soil the total rainfall must be well in excess of 30 inches. As will be seen later, cotton yields on the heavier and more retentive soil at Maperera were far higher than those obtained at the Station.

<i>Month.</i>	1929/30.		1930/31.		1931/32.	
	<i>Rainfall Inches.</i>	<i>Rainy Days.</i>	<i>Rainfall Inches.</i>	<i>Rainy Days.</i>	<i>Rainfall Inches.</i>	<i>Rainy Days.</i>
November ...	2.21	6	0.82	4	1.05	3
December ...	7.21	10	7.07	15	4.45	18
January ...	2.28	11	6.22	17	7.15	10
February ...	1.13	6	5.53	17	5.41	12
March ...	9.50	10	1.85	9	4.06	11
April ...	0.93	7	3.03	11	1.63	6
May ...	0.66	4	0.23	3	1.37	5
June ...	0.80	4	0.99	9	0.23	3
July ...	0.29	5	0.27	1	0.41	4
August ...	0.37	2	—	—	0.16	4
September ...	0.60	1	—	—	0.51	3
October ...	0.02	1	1.01	3	nil to	21/10/32
Total ...	26.00	67	27.02	89	26.43	79

GENERAL.

A total of fifty acres was under crop, of which 25 acres were cotton (strains of U.4.) grown experimentally. The balance of 25 acres was devoted to native food crops, oil seeds, pulses, etc., which take their place in the various rotations.

The total production for the season was 6,080 lbs. of seed cotton, and the average yield per acre obtained was 243 lbs. seed cotton of which 78 per cent. was clean and white. The highest yield per acre of seed cotton was 567 lbs., produced on a 2½ acre propagation plot of U.4/5/5.

FIELD EXPERIMENTS.

These included (a) Strain tests of various U.4 lots, (b) Time-of-planting and (c) Spacing trials. Five single $\frac{1}{2}$ -acre observation plots, each of which carried cotton interplanted with a food crop, were also grown with a view to obtaining some information upon systems of mixed cropping which are a feature of native agricultural practice.

Bulk sowings of U.4/5/1, U.4/5/5, U.4/5/12, and bulk U.4 were also grown in $2\frac{1}{2}$ -acre propagation plots. From these plots cage seed was picked and retained for the 1932/33 sowings, U.4/5/12 showed marked jassid susceptibility and was discarded. All surplus seed not wanted on the station was used as a mixed bulk for distribution to the various native areas.

Some of the results may be significant, but up to the time of writing this report there has as yet been no opportunity to analyse them statistically. The figures are, however, of interest in terms of acre yields, and the means are therefore included in tabular form under the head of each experiment.

U.4 mixed bulk was used throughout unless otherwise mentioned.

STRAIN TEST 1.

<i>Strain.</i>	<i>Date of Planting.</i>	<i>Spacing.</i>	<i>Number of plants per hole.</i>	<i>Seed Cotton lbs. per acre.</i>
U.4/2	March 4th-7th	3' × 2'	2	204
U.4/4/2	" "	" "	"	192
Mixed bulk Domira Bay	" "	" "	"	215
Local	" "	" "	"	235

STRAIN TEST 2.

<i>Strain.</i>	<i>Date of Planting.</i>	<i>Spacing.</i>	<i>Number of plants per hole</i>	<i>Seed Cotton lbs. per acre.</i>
U.4/5/12	March 1st-3rd	3' × 2'	2	248
U.4/5/5	" "	" "	"	280
U.4/5/1	" "	" "	"	266
Mixed bulk, Local	" "	" "	"	305

Strain test (2) was duplicated at Maperera in the Chikwawa district on a rich, heavy, retentive, alluvial soil. The figures below show the difference between this and the light, sandy alluvium of the Station, under very similar rainfall.

<i>Strain.</i>	<i>Date of Planting.</i>	<i>Spacing.</i>	<i>Number of plants per hole.</i>	<i>Seed Cotton lbs. per acre.</i>
U.4/5/12	February 22nd.	3' × 2'	1	1040
U.4/5/5	" "	" "	"	1105
U.4/5/1	" "	" "	"	1300
Mixed bulk, Local	" "	" "	"	1106

TIME OF PLANTING EXPERIMENT.

<i>Planting Date.</i>	<i>Spacing.</i>	<i>Number of plants per hole.</i>	<i>Seed Cotton lbs. per acre.</i>
January 4th	3' × 2'	2	263
" 15th	"	"	188
February 1st	"	"	260
" 16th	"	"	74
March 4th	"	"	48
" 16th	"	"	26

SPACINGS.

<i>Planting Date.</i>	<i>Spacing.</i>	<i>Number of plants per hole.</i>	<i>Seed Cotton lbs. per acre.</i>
February 22nd	3' × 3'	<i>Unthinned.</i>	82
" "	3' × 3'	2	110
" "	4' × 6"	2	121
" "	4' × 12"	2	145
" "	4' × 18"	2	115
" "	4' × 2'	2	146
" "	4' × 2'	1	37
" "	3' × 6"	2	67
" "	3' × 12"	2	105
" "	3' × 18"	2	147
" "	3' × 2'	2	51
" "	3' × 2'	1	102

The food crops represented in the following results from the observation plots were planted in rows alternating with the rows of cotton. The inter-row spacing was 2' throughout, the spacing within the row in the case of the cotton being also 2'. All the crops were planted on January 28th.

<i>Mixture crop.</i>	<i>Seed cotton lbs. per acre.</i>	<i>Intra row spacing. Mixture crop.</i>	<i>Yield per acre. Mixture crop.</i>
Macheweri (<i>Pennisetum typhoideum</i>)	38	9"	406
Mapira (<i>Sorghum vulgare</i>)	13	12"	72
Pigeon Pea (<i>Cajanus indicus</i>)	8	6"	127
Maize sp. Honduras	147	15"	88
Lima Bean (<i>Phaseolus lunatus</i>)	160	12"	14

The heavy shade of the first three crops depreciated the yield of cotton enormously.

NIGERIA

REPORT OF THE WORK CARRIED OUT AT THE CORPORATION'S SEED FARM, DAUDAWA, NORTHERN NIGERIA, FOR THE YEARS 1931 AND 1932.

BY

G. BROWNE.

SUMMARY.

Cotton.—In 1931 there were 500 acres under cotton on the Farm itself, and this produced 110,007 lbs. of seed-cotton, an average of 220 lbs. per acre. The Co-operative Farms, with an acreage of 45 acres gave 10,896 lbs., an average of 242 lbs. per acre. The highest yield from any field (20 acres) on the Main Farm was 360 lbs. per acre, while that from the Co-operative Farms was 450 lbs. per acre. In all 120,903 lbs. of seed-cotton passed through the ginnery, a small increase on the previous year. This yielded 35,929 lbs. lint, 84,100 lbs. seed and 874 lbs. waste. The bulk of the seed (all of which was discarded for reasons given later), was used as fodder at this and various of the Agricultural Department's Stations. The average ginning percentage was 29·96% lint. All lint was pressed and baled at Funtua Ginnery for transit to England, and 84 bales of No. 1 and 5 bales of No. 2 lint were shipped. The broker's report on the No. 1 was "Strict good middling, Creamy colour, Staple full $1\frac{1}{8}$ " but rather rough, moderately strong. Value 5·30d. based on American Futures @ 4·30d." Regarding the No. 2 lint (which was sent home for the first time), the broker reported "Middling, stained, Staple $1\frac{1}{16}$ " and $1\frac{1}{8}$ ", soft. Value 3·00d. based on American Futures @ 3·70d."

There were 640 acres planted in cotton in the season 1931-32 and this area produced 158,098 lbs. of seed cotton, which gives an average of 247 lbs. per acre an increase of 27 lbs. on last year. Five special strains were planted namely J., G., U.4., H.21., and D. These occupied approximately 20 acres each. The rest of the farm was in bulk B.C.G.A. The Co-operative Farms, the estimated area of which was 59 acres, yielded 15,363 lbs. or 260 lbs. per acre. The maximum yield from any field on the Main Farm was 367 lbs. per acre, and on the Co-operative farms, 390 lbs. per acre. Total seed-cotton passed through ginnery was 173,461 lbs. and the result was 51,827 lbs. lint ; 120,810 lbs. seed and

730 lbs. waste. The average ginning percentage was 29.86% lint. A large quantity of the seed was sent to the Departmental Stations for cattle fodder, none of it being considered fit for further propagation.

According to the broker's reports on the lint of the special strains none was really outstanding. Values were from 4.40d. to 4.60d. per lb. for the special strains, as against 4.50d. to 4.55d. per lb. for the B.C.G.A. Ordinary, all prices being based on June American Futures @ 3.90d. per lb.

The season was remarkable for the very small amount of No. 2 grade cotton.

Clearing.—In the year 1931, 220 acres were cleared and put under cultivation, thus bringing the Main Farm to 900 acres, whilst in the following year, owing to the financial situation and the fact that there was no immediate necessity for an increased acreage, the Corporation decided that no further clearing should be undertaken for the time being. The area cleared and under cultivation therefore remains as at the end of the previous year, *i.e.*, 900 acres.

Cropping.—The cropping schedule in 1931 was as follows; Cotton 640 acres; Beans 180 acres; and Cereals 88 acres. Five different special strains of cotton were planted in 20-acre fields (making 100 acres) and the rest of the area, 540 acres was planted in B.C.G.A. Ordinary. An experiment was started to test the practicability of growing Bulrush Millet as a catch crop before cotton. Mucuna beans were again planted as a green manure crop.

The following season, 1932–33, 650 acres of cotton were planted; 224 acres cereals; 120 acres beans, also 20 acres Sann Hemp for green manure crops; 60 acres of groundnuts. Strain L was the cotton sent by the Agricultural Department for multiplication and 260 acres were planted with this on the Main Farm, the remainder being in B.C.G.A. Ordinary. The experiment of growing millet as a catch crop prior to cotton was carried on in two of the same fields as last year and extended to others. In addition, millet was grown through groundnuts on 60 acres. It is probable that, should these experiments show that mixed cropping, when run in conjunction with cattle cultivation, and a consequent supply of F.Y.M. has no deleterious effect on the cotton yields in subsequent years, a modification of the cropping scheme may be adopted which will enable the farm to play an effective part in the plans of the Agricultural Department for improving native methods of farming in Northern Nigeria.

Cattle.—Cattle cultivation made great strides during the past two years, notwithstanding the fact that very heavy losses have been experienced from one cause or another, principally from trypanosomiasis.

In the first year under review 13 cattle died which left 35 animals alive ; in the second year 45 cattle were killed or died, 39 were purchased and 1 bred making 40 in all, which now leaves the herd only 30 strong. (The situation will be enlarged upon later on in this report). The seasonal work of the farm is now mostly done by cattle, and they have enabled great economies to be effected in the working costs of the station.

Co-operative Farms.—Since the last full report was published (in 1930) 8 farms have been made, 6 in 1931 and 2 in 1932. There are therefore 24 farms now in occupation, though the last two still require houses to make them complete.

RECAPITULATORY.

At the time of writing the last full report (Nov. 1930), the Main Farm comprised 680 acres, all of which were under cultivation. This area has, during the period under review, been increased by 220 acres, and the farm is now 900 acres in extent. Further clearing is suspended for the time being. The acreage under cotton has increased by 150 acres. Mixed cropping, which had not then been started, is now being practised.

Cattle cultivation was really only beginning in earnest at that time, and has progressed rapidly notwithstanding the heavy losses by disease. Mechanical cultivation is not practised now except at very busy times and then to a very small extent only. Fifteen D.Y. ploughs are now in constant use throughout the season and by means of these and many other implements, over 1,300 acres per annum have been cultivated with cattle. Little use was then being made of farmyard manure, whereas now a large area is treated thus annually. Cattle camps have been established at four different points.

Co-operative Farms have proved quite successful in their way, the number now being 24 as against 16 in 1930. There is still no lack of tenants to occupy the farms as quickly as they are made, though the programme has been slowed down during the last year.

CLEARING.

In 1930 this work commenced towards the end of October, while the ground was still more or less damp below the surface. The site of the next Extension to be tackled was to the South of the Main Farm and is marked Extension 3 on the plan. The area to be cleared was approximately 220 acres and the work was concluded in March.

The land on the new farm was eminently satisfactory so far as drainage and quality were concerned, and contained practically no

outcrops of stone. The bush over almost all the extension was extraordinarily heavy, and consequently the cost was somewhat higher than usual, and the disposal of the heavier timber presented a more difficult problem. This was too thick and green to burn and the largest had to be pulled off with the Guy tractor. The majority, however, was hauled off by teams and pairs of cattle and provided excellent practice for both them and their drivers. These logs were taken to the Ginnery for fuel.

A large proportion of the land cleared was formerly owned by native farmers, which makes the cost of clearing higher, and good farming more difficult (as explained in the report for 1930). It is much more satisfactory to clear and farm virgin land, than that previously imperfectly cleared. During the past year no clearing has been undertaken, the Corporation in consultation with the Director of Agriculture having agreed that neither the financial position nor the requirements of the Department warranted further extension for the present.

GENERAL CULTIVATION.

At Daudawa, where a large area has to be broken in a very limited time, a certain amount of preliminary work must be done prior to the rains, especially when clearing is necessary also. For this purpose Sabul ploughs were tried in November 1930, but the ground was so hard that a team of six oxen had to be used. The work was heavy and uneconomical, while the results were also rather disappointing. A 3-disc plough drawn by the Guy lorry was tried, but the tracks on the latter wore out after 20 acres had been done. A 2-furrow disc plough drawn by five pairs of bullocks did a further 20 acres at a rate of $1\frac{1}{2}$ acres a day, and the rest of the area, 140 acres, was broken by hand. The Nigerian soil bakes so hard that there seems to be no small plough that will deal with it effectively in the dry weather.

An R.S.L.D.-X. double furrow plough was used most successfully after the rains commenced. The work done by this implement is exceptionally good and its draught is light. A form of cotton stalk cutter was evolved from a pair of wheels and an axle on which was mounted a Queen harrow. A certain number of alterations were made to the controls to enable the gangs to be set at the required angles in order to engage the rows of cotton stalks. The work was moderately satisfactory, after various changes in methods of draught and elevation had been made and the results were sufficiently encouraging to make this worth while. The cost per acre worked out at roughly 50% of hand labour. A pair of centre-breakers of foreign manufacture were tried,

but these proved incapable of standing up to the work though their design was excellent. The D.Y. plough is still the most used implement on the farm, 15 of them being in constant use during the rainy season.

The cultivation costs have been greatly reduced during the past two years. The principal factors enabling this to be accomplished have been (a) cattle cultivation, and (b) the general depression which has led to a large excess of labour and a consequent fall in the daily rates of pay. The latter are a third less than when work started at Daudawa in 1925-6 and are based on the official Government rates. Added to the above, experience gained in past years has gradually shown how the cost of almost every operation can be reduced each year.

While it is generally recognised that it is impossible to cultivate a large farm in the tropics as thoroughly as in England, it may well be that even now too much preparatory and inter-crop cultivation is done. Although it is next to impossible to clear all the land of weeds over a wide area in the short time available here, constant weeding and working of land seems to break up the soil to such an extent that it becomes almost fluid with the first heavy downpour. It is noticeable that a native's farm rarely suffers from erosion, even though it be within a stone's throw of a European-supervised station, where erosion after some years is prevalent. This is attributed to the fact that he rarely touches his land until immediately before sowing his crop, when a sort of half-turf has formed, which, when turned, appears to withstand the subsequent rains and keeps wonderfully free from weeds.

To what extent mixed cropping can help the situation, by the planting of early cereals or other crops which will keep down weeds and thus avoid the necessity of stirring the land so often, remains to be seen, but, on the assumption that the above theory is correct, it seems almost certain that something of that nature is called for if erosion is to be checked.

CROPS.

Cotton.—Towards the end of the 1930-31 season, the crop had been very badly affected by jassid and it was feared that very little cotton, if any, might be obtained. Later, after the worst of the attack was over, a number of bolls ripened on the upper branches, and provided a fair yield, but nothing in comparison with that which had been expected before the jassids made their appearance. On the Main Farm, 500 acres were planted in cotton, the seed being Strain "D," and the greater part of this area was affected. The worst period appeared to be about the middle of November, and after this time the plants began to make a little headway. The fields most severely

attacked were the earlier planted ones, and they also suffered the most damage. The Co-operative farms experienced the attack, but much more lightly, the yields there being very little affected by it. This year also saw the worst attack of the Sudan bollworm since the farm was started ; this would have been much more worthy of note, had it not been overshadowed by the jassid attack. Between the two, the fact that the average yield from the Main Farm was 220 lbs. per acre, as against the previous year's average of 284 lbs. must be considered satisfactory.

Picking commenced on December 29th, rather later than usual, and was completed on the 25th of February. For the reasons given above, it can readily be understood that, although the acreage under cotton had been increased, the total yield of seed-cotton was little in excess of the previous year's figure. The highest average yield per acre in any one field was 360 lbs., against 433 lbs. per acre for the previous year. The total amount of seed-cotton (No. 1) was 102,097 lbs., while that of No. 2 grade was 7,910 lbs., the larger proportion of this to No. 1 being due to stainer and bollworm damage.

Owing to the apparent susceptibility to jassid of the Strain "D" cotton, the Department decided that, for this year at any rate, the seed from this cotton should not be sent to the Dan Ja area for further reproduction. The Director of Agriculture agreed that it should be distributed amongst those Agricultural Stations where cattle are kept, and a certain proportion kept at Daudawa for cattle consumption.

With a view to finding a more jassid-resistant strain than Strain "D," the Department suggested to the Corporation that other strains of cotton be tried at Daudawa in fairly large areas as part of the next year's cropping programme. Four new strains were accordingly planted in 1931-32, each occupying approximately a 20-acre block, while one block of Strain "D" was planted for the purpose of comparison ; these were grown, harvested and ginned separately and a general observation kept upon them. Fields lending themselves to isolation were chosen for these strains. The objects in view were as follows :—(1) To get an indication of the behaviour of the different strains at Daudawa as compared with the Government Stations at Samaru and Maigana, especially as regards jassid resistance ; (2) By ginning the lint on the Corporation's gin running at a commercial speed (as against the hand gin at Samaru) to obtain more reliable comparative results from both the ginning tests and the broker's valuation ; (3) In the event of any one or more of these strains being considered suitable for further reproduction a considerable quantity of seed would be available next season, thus saving a year in the multiplication scheme.

The new strains chosen were H.21-3, J., G., and U.4. The U.4 seed was especially obtained from South Africa by the Corporation. The seed-rate for these blocks was 10 lbs. per acre. The rest of the farm was planted in B.C.G.A. Ordinary, at the rate of 15 lbs. per acre. Planting began on June 27th, the date being rather delayed owing to a dry spell of weather; the special strains were planted on July 13th and 14th. The rows were again 3' apart and the distance between stands 18". Germination over the whole farm was very good, few supplies being necessary. Supplying and thinning were continued when needed until the end of August. The first hand-weeding which was begun about the end of July, was followed by a ridging-up with the D.Y. ploughs when the plants were a little stronger. The greater part of this work was done by cattle except in those fields where bars had been made or other difficulties existed. Two fields were given a dressing of farmyard manure at the rate of about 1 ton to the acre, and this had a very beneficial effect. The first flower was seen on August 23rd. Mulching was done throughout October and early November.

A certain amount of boll shedding took place in August and early September; the Sudan bollworm was again present. Leaf Roll, caused by the Cotton Leaf Roller (*Sylepta Derogata*, Fabre), was also prevalent, but the principal damage was due to jassid. An experiment was carried out in the first two fields sown, the plants in which had already begun to "spindle" and were slightly attacked by jassid, with the object of seeing whether "topping" would have any beneficial effect on the crop by staying the growth and encouraging fruiting on the lower branches. Alternate two-acre strips were "topped" while the intermediate strips were left untouched. The result was not altogether in accordance with expectations, for the "topped" plants were almost denuded of fruit, while the untouched plants, after the jassid wave had passed, threw out the usual top crop of a few bolls per plant. The plants, deprived of their top, were apparently unable to throw out new fruiting branches after the jassid attack has passed. The jassid attack persisted until December, but was not so severe as in the preceding year. Bollworm damage was, however, heavier than usual.

The rain was about normal in quantity, but the incidence was not particularly good. A dry period in July delayed planting operations, while heavy rains at the end of that month, and in August and early September caused serious erosion. Attempts to counter this by ridging in such a manner as to allow the surplus water to get away as quickly as possible was fairly successful, but the problem is a difficult one, and perhaps terracing would be the most efficient method, though

it would be very expensive to carry out at Daudawa. The rains finished at the end of September and the harmattan began almost immediately, so that for the first time for six years, there was no October rain which has such a beneficial effect on the cotton crops of Northern Nigeria.

To return to the growing crop. Flowering, which commenced late, was very heavy towards the end of the season. Picking did not begin until January 4th which is late for this station, but continued to capacity throughout the ginning period. The special strains were kept separate throughout and were picked, bagged, stored and ginned under careful supervision. Moreover, these strains were not ginned until the whole of the bulk B.C.G.A., from the rest of the farm, had been through the ginnery. A noticeable feature, both in picking and ginning, was the very small amount of No. 2 grade cotton. Towards the end of the picking season it became obvious that owing to jassid and other pests no outstanding yields would be obtained and, although the average yield was slightly in excess of that of the previous year, it did not approach those of the two former years. The final figures showed that 156,811 lbs. of No. 1 grade and 1,287 lbs. of No. 2 grade cotton were produced from the 640 acres under this crop, an average of 247 lbs. per acre, as opposed to 220 lbs. last year and 284 lbs. the year before. The highest average individual yield in any field was 367.5 lbs., rather higher than last year's figure of 360 lbs. but much less than the previous year's average of 433 lbs. Included in the above figures were the yields of the special strains which totalled 29,058 lbs. The average yields per acre of these, over 20 acres, were as follows:—Strain "G," 233 lbs.; U.4, 287 lbs.; H.21-23, 303 lbs.; Strain "J," 310 lbs.; and Strain "D," 276 lbs. The No. 1 Lint produced from all sources amounted to 51,395 lbs., and the No. 2 Grade was only 432 lbs. No one of the special strains produced during the past season, was considered good enough to warrant further multiplication, so the seed was again used for cattle fodder.

A considerable quantity of cereals must be grown annually to provide food for native labour and for cattle, and as these cereals take up a fairly large area of land, it was thought that at all events a portion of them might be grown preceding cotton on the same land. Bulrush millet, the maturing date of which was suitable, was the crop selected for the experiment, the object of which was to find out whether a catch-crop of millet would reduce the subsequent yield of cotton and if so, whether the reduction in yield would be compensated by the cotton that could be grown on that area which otherwise would have had a crop of cereals grown upon it. The average number of bundles of millet

per acre from the experimental plot was $20\frac{1}{2}$ against an average of 19 bundles per acre from the three best fields on the farm planted wholly in cereals. The average cotton yield from the four plots laid down was 288 lbs. per acre as against 327.5 lbs. per acre from the controls and a general farm average of 247 lbs.

For the season 1932-33, the Agricultural Department decided to multiply a cotton known as Strain "L" on the grounds that its lint had received a good broker's report and the crop had done well at Maigana. Seed amounting to 2,530 lbs. were supplied with the request that as great an area as possible should be planted, and areas of 260 acres were chosen that could be isolated from the remainder of the farm. In addition, it was decided that all the 24 Co-operative Farms should be supplied with this seed, their estimated acreage being 75, which brought the total to be planted in "L" strain to 335 acres; the seed rate could therefore, not exceed 7.5 lbs. per acre. The rest of the farm under cotton (380 acres) were to be planted in B.C.G.A. Ordinary. (Actually another 10 acres were sown in cotton after a crop of Sann Hemp had been turned in, thus making a total area under cotton on the Main Farm of 650 acres). 160 acres of land for the 1932-33 crop had received a dressing of farmyard manure at the rate of about 1 ton to the acre.

It was decided that the initial planting date should be still further retarded this year, and planting did not commence until the 4th of July and finished on August 2nd. Up to the time of writing, November, there has been every indication that this plan has been very successful indeed; only one field has shown signs of any "spindly" growth, and it is thought that the later planting period is responsible for the fact that jassids, though admittedly present in smaller numbers, are doing practically no damage this year, and this is true also of other pests such as the Sudan bollworm, etc.

The fields to be sown in B.C.G.A. were planted first, and the optimum planting period of July 10th to July 15th was reserved for the special strain. Unfortunately, July was unusually dry and this caused the planting to be rather protracted, and the germination, especially of "L," was not very good. When this was seen to be the case the number of seeds per hole for this cotton was reduced from 3 to 2 in order to allow for supplies. With stands 18" apart in 3' rows, the seed-rate was thus only about 4 lbs. per acre. The seed-rate of the B.C.G.A. cotton was about 10 lbs. per acre, while the final seed-rate for the special strain was the maximum available, *i.e.*, $7\frac{1}{2}$ lbs. An attempt was made to sow the special seed 2' apart so as to enable cross cultivation to be

carried out, but this had to be given up as the planting cost proved to be too heavy.

Throughout the rainy season, great care had to be taken with the Strain "L" cotton, and this naturally had prior attention. Even now the stand is not to be compared with that of the bulk B.C.G.A., but this is not to be wondered at when the restricted seed-rate and the dry period in what ought to have been the optimum planting time, are taken into consideration. On the other hand, the crop over the whole farm is by far the best and most promising yet seen. Moreover, it is unlikely that jassid will inflict much damage from now on. Fruiting is heavier by far than in any of the 6 previous seasons, beginning on the lower branches which in other years have rarely borne fruit. How much of this result is due to the later planting date and how much to a good cotton year in this area generally, is difficult to say. The incidence of rainfall certainly could not be called good by ordinary standards, record high falls being recorded in April and May, with a low record fall in July. The later rains were good, however, and lasted until October the 20th.

It is becoming obvious that some change of cropping policy is likely to be advantageous at Daudawa. Now that cattle are being used and a supply of F.Y.M. is available, it is no longer necessary to plant so large a proportion of the farm in beans for green manure. This area can thus be used for revenue crops, and the land can be manured before the cotton crop is sown, thereby saving a year in the manuring process, and reducing the net cost of the station. Again, the growing of revenue-producing crops before or at the same time as cotton or other crops, would be possible by the use of cattle manure.

It has been mentioned that an experiment was begun last year to test the practicability of growing a catch-crop of grain on the same land as that on which cotton was to be planted. The yields for that year were found to be satisfactory, and the experiment was continued this season on two of the same fields as last year, the other two being unavailable. The layout was exactly the same, but owing to locust damage early in the season the two plots planted in millet did not give such good results, the yields being 17 and 18 bundles as against 35 and 57 bundles last year for the same two fields. The yields for the cotton-crop from these plots will not be obtainable for some weeks yet. In addition to these two plots, the scheme was extended, and in all, 80 acres of millet were grown through cotton, the spacings of the former being varied to find out which gives the best results. The yields of millet from these fields were satisfactory, considering that the spacings were wide

and that no attempt was made to obtain a big crop. It is also thought that the millet tends to prevent excessive erosion and shelters the young cotton plants in their earlier stages. Unfortunately, the price of grain is so low this year that very little revenue can be expected, but however small it may be, it has been obtained at practically no extra expenditure above that required by the cotton crop.

Beans.—In the 1931 season, 180 acres of land was planted in Mucuna Beans. The seed supply was small, due to the fact that the yield from the seed harvested from the previous year's crop did not come up to expectations. A low seed-rate was used in consequence, but owing to a dry period following sowing, poor germination ensued and further supplies were necessary to ensure a good cover crop.

All planting was done by hand, as was also the first weeding, but the subsequent inter-crop cultivation was done with Midget Cultivators drawn by cattle. Notwithstanding a poor start, there was quite a good cover on the land when the time arrived for ridging the beans in. They were turned in and ridged by hand, the D.Y. ploughs being just too small to lay sufficient soil on the top. Two of the later planted fields, which had only a poor cover when the time came to ridge the beans in, were left for seed, and over 9,000 lbs. were obtained, an average of 228 lbs. per acre. This is more than is required, but it will probably be possible in consequence to harvest less in the coming season.

This year the area hitherto allotted to beans has been somewhat broken up with a view to getting information as to the suitability of alternative crops which would give the same or better results and provide some revenue at the same time. With this object 120 acres of Mucuna beans were sown in the ordinary way, and 60 acres of groundnuts; 20 acres of Sann hemp were also sown in place of one field of beans, thus making a total of 200 acres under one form or another of a green manure crop; the object in planting the groundnuts was to harvest the nuts and make the tops into hay for cattle fodder, returning the crop to the land later in the form of F.Y.M.

The beans were planted at the end of May and beginning of June. They were later weeded and in this work the locusts gave useful assistance. The germination was remarkably good and few supplies were necessary. Small cultivators were later run through the crop, and proved very useful for the inter-crop cultivation between the young plants. The beans were turned in for green manure in September, with the exception of 10 acres which were left for seed. The foliage was heavy and the cover exceptionally good. Two hundredweights of seed were sent to the Superintendent of Agriculture, Kano.

The area sown in groundnuts has been a decided success and good yields are being obtained from the 60 acres. A crop of widely spaced millet was also grown upon the same land, but owing to its later planting date and to locust damage, the yields from this crop were not very good. The groundnuts could, with advantage, have been sown nearer together, and closer spacing will be tried next year. The weeding and inter-crop cultivation were done with Midget cultivators. The nuts are being picked by hand, as the tops are wanted for hay for cattle fodder. A small ground nut sheller has been purchased and this will be run by the engine at the Ginnery. Final yields are not yet to hand.

Different ways were tried of sowing the Sann hemp, half the field being sown in rows 1', 2' and 3' apart with the seed running continuously, and the other half was sown broadcast: the latter method of sowing produced a much heavier cover crop. The seed-rate throughout was approximately 45 lbs. per acre. One half of the field was turned in in early August and cotton planted upon the ridges. One third of the remainder was cut for silage and one third for hay, while the remaining third was left for seed. The cattle, however, would not eat the hay and have since refused to eat the silage. The seed will be harvested in due course.

Millet.—Cereals of all kinds produced excellent crops in the Northern Provinces in 1931, and this station, for the first time, had a really good crop of millet to harvest. Bulrush millet seed was sown as in other years: sowing commenced on April 24th. There were 104 acres in this crop, including the 8 acres sown in connection with the experiment of growing millet as a catch crop before cotton. One field was given a dressing of F.Y.M. before being planted, and another field was similarly treated after the millet had been removed. These two fields had been scheduled for cereals through beans, but owing to the shortage of bean seed, this method of manuring was used, and judging from the crop of millet produced, has answered remarkably well. The total number of bundles harvested were 1,528, an average of upwards of 600 lbs. to the acre over the area planted which included many patches of poor land.

The following year, suitable planting rains fell on the 26th April and sowing began the following day. This time a much larger area was planted in millet mixed with other crops, viz., 60 acres through which Guinea-corn was grown later, 60 acres on land on which groundnuts were to be planted, and 80 acres which were to have cotton grown through them, making 200 acres in all. Various spacings were tried from 6' to 12' between stands. According to the yields obtained the

results are rather indefinite, varying, no doubt, with the state of the particular field in which the millet was sown, and also the nature of the other crop with which it was sown. Damage by locusts lowered the final yields. Cattle did all the inter-crop cultivation while the plants were still small, but the final weeding and ridging-up was done by hand. The crop was harvested in August, the total yield being 54,318 lbs., an average of 266 lbs. per acre. (These figures include the yields from the experimental plots which are given in the "Cotton" section.)

Guinea-corn.—This crop in 1931 was grown through the millet, with the exception of 8 acres of the latter in the millet-cum-cotton experiment. Thus, an area of 96 acres were planted, sowing commencing at the end of April. A sample of improved guinea-corn was obtained from Samaru, and one acre was planted with this. The crop did very well from the beginning, the rains and weather conditions being eminently suitable. The inter-crop cultivation was the same as that given the millet, both crops being grown together. The total yield from the 96 acres, which included the strips planted to assist in the isolation of some of the plots of special cotton, was 47,368 lbs., an average of 493·4 lbs. per acre. Yields in individual fields went up to 968·75 lbs. per acre. Heavy stocks of grain were held at the end of the season, and the opportunity was taken to buy up a quantity of grain from outside sources, in view of the extremely low prices.

In the year 1932, 60 acres were sown in Guinea-corn, planting being commenced in May. It was again sown in fields in which millet was already growing. Locusts were responsible for much damage to the young crops, in fact, one field sown in maize for purposes of comparison was completely wiped out and the experiment abandoned owing to shortage of seed. The guinea-corn survived the attack wonderfully well, however, but no more than a normal yield is likely, a dry period in July having kept the crop back considerably.

THE GINNERY.

A new Dobson & Barlow 40-saw gin was erected towards the end of 1930 before the ginning season commenced. A total of 112,993 lbs. of seed cotton was passed through the ginnery in 1931, and this produced 33,851 lbs. of lint, 73,800 lbs. of seed and 842 lbs. waste, the average ginning outturn being 29·96%. The No. 2 grade seed cotton amounted to 7,910 lbs., and the ginning outturn was 26·27%. All the No. 1 lint was pressed and baled at Funtua and No. 2 at Zaria, Funtua Ginnery by that time having closed down for the season.

The fitting of laminated belts in the ginnery was a great improvement, adding much to the efficiency and safety of the plant.

Owing to the separate picking and ginning of the special cottons for the Agricultural Department in 1932, the ginning procedure was rather more complicated. The yields per acre of seed cotton of each strain have been given already in the Cotton section of this Report.

Each of the 5 special strains of cotton grown, "J," "G," "U.4," "H.21" and "D," occupied roughly a 20-acre field. Three pickings were made, where possible, of each and each picking was ginned separately. The average ginning outturn of the three pickings were :— "U.4," 32.08% ; "G," 29.98% ; "D," 29.62% ; "H.21," 29.30% ; "J," 26.90%.

The total quantity of seed cotton passing through the ginnery, and of the lint produced are given in the Summary at the beginning of the Report.

When the ginning season was over some experiments were tried in ginning small quantities of lint on the gins, with a view to devising a means whereby the lint from the Government Botanist's plots at Samaru could be ginned on a gin running at commercial speed, in order that satisfactory samples could be sent home for broker's reports. The experiment was carried out by removing the 14th saw (out of 40), thus dividing the seed-roll box into one-third and two-thirds respectively and inserting a 3-ply wood partition suitably shaped in place of the saw. A wooden support along the top held the partition in place. It was found that broker's samples could be obtained from 12-15 lbs. of seed cotton with ease ; the different sized seed-rolls rotated normally, but of course they had to be hand-fed.

COTTON SEED DISTRIBUTION.

It will be remembered that the seed from the season 1930-31 was discarded on account of the fact that it was considered unsuitable for further multiplication. There were 84,100 lbs. and of this 60,800 lbs. were sent to Zaria for distribution amongst those Agricultural Stations where cattle are kept, for fodder. The balance was retained at Daudawa for the same purpose.

In the following season, none of the 5 special strains grown came up to the Agricultural Department's expectations, so that the resultant seed had once more unfortunately to be discarded. The seed, including the B.C.G.A. bulk used on the rest of the farm, amounted to 120,810 lbs. ; of this 44,800 lbs. went to Samaru, 22,400 lbs. to Shika Stock Farm, and 22,400 lbs. were sold to the Veterinary Dept. at Vom. Outside farmers in the vicinity were supplied with 700 lbs. for the purpose of sowing their farms this season, though the seed-cotton will, of course, not be re-purchased at Daudawa.

LABOUR.

There was a marked excess of labour available above requirements in the past two years, owing to the general trade depression. Cattle cultivation has also reduced the number of men normally required on the farm, though at busy times such as planting and harvesting, extra labour is always wanted to deal with the seasonal work. This is now always easily obtained, and can be had at the shortest notice. Many of the original employees are still working and constitute the basis of the permanent labour staff. Co-operative farmers also form an increasing proportion of the labour staff, and at slack periods they go and work on their own farms. Many of the camp labourers also, who have been here a considerable time, have their own little plots of land on which they grow their food supplies. These are encouraged both because they thus tend to become more permanent and also because their plots are selected for them, so that they assist in keeping the watercourse clear of the bush which harbours the tsetse fly and causes trypanosomiasis in cattle.

Rates of pay were reduced in 1931, the new rates being based on those paid officially to Government labour. Short time has been worked consistently in the slack periods; this system is very popular with the men, as it enables them to earn just sufficient money for their needs, and also to attend to their own work and go to the market on the off-days.

During the past twelve months a completely new factor has affected the labour market, namely, the anxiety of women to come to work. Formerly, it was with the utmost difficulty that they could be induced to plant or pick cotton, and then only in very small numbers. This season no less than 50 have been at work amongst the groundnut crop, and this number could be doubled if required. They make good and cheap labour for certain forms of work, and seem very glad of the opportunity to get employment.

The health of the camp has been good throughout, and no outbreak of disease has been recorded. There are usually a few cases of incidental sickness or guinea-worm towards the end of the rains, but nothing worthy of special mention.

There were 5 deaths in 1931 and 3 in 1932, the latter being the lowest figure for some years past. The average daily attendance in 1931 was 199, and in 1932 the number had dropped to 163. A census taken in 1931 showed a population of almost 500 persons resident in the labour camp.

CATTLE AND STOCK.

At the time of writing the last report there were 25 cattle in the Daudawa herd. These have been added to from time to time when

opportunity permitted. It was thought at the time that those cattle which were bought locally were the source of much trouble and sickness in the herd, but the impression now is that the trouble was not due to the poorer quality of the locally purchased animals, but rather to the fact that their subsequent treatment here was at fault. The cattle which were not locally purchased came from the Veterinary Department at Vom and before leaving there had been immunised against almost every disease to which an animal might be exposed in this country and to which immunisation was applicable. They were also used to being handled and arrived in good heart, having been fed on concentrates etc. for some weeks past. The locally purchased animals arrived, and, after a period of isolation, were put to work in the same way as the Vom cattle, but necessarily without the immunisation, feeding and other care which the other cattle had had previously, though of course the feeding arrangements are the same afterwards. Latterly many local cattle have been bought, but the method of keeping them is altogether different. Deaths have been many admittedly, but they were not due to the same causes as before, the local purchase now having the same inoculations and immunisations as its neighbour from Vom. Owing to the better understanding of local conditions it is now thought that all the cattle stand an equal chance from whatever source they may come, and the warm thanks of the Corporation are due to the Veterinary Department who have so willingly assisted in every way and have undertaken to provide inoculations etc. when necessary.

In 1930 there were 3 deaths leaving a herd of 25 ; in 1931, 13 cattle died leaving 35 alive ; while in 1932, which has been the most disastrous period yet experienced, no less than 45 cattle have died, the herd now being only 30 strong. The financial aspect of these losses is not important : the proceeds of the sale of meat have, indeed, rendered it almost negligible. It is their effect on the extension of this means of cultivation that is more serious.

The excessive mortality during the past year has been largely due to trypanosomiasis, deaths from other diseases being about normal. The main contributory causes for the increase of tsetse fly infection include (a) insufficient appreciation by the Veterinary Dept. in the past, that this is a tsetse fly area, (b) working the cattle too hard and for too long hours, and (c) faulty arrangements for grazing and food supply. The Veterinary Officers now state that although most of the cattle here show trypanosomiasis in their blood on microscopical examination, very few tsetse flies are actually to be found, so that presumably, the infection had been already acquired elsewhere, but

owing to the conditions obtaining at Daudawa hitherto, the disease has lain dormant until the resistance of the animal was lowered by hard work. However, as stated previously, the valuable experience gained during the past few months has resulted in many changes in the methods of cattle management here, and it is now hoped that, with the assistance of the Veterinary Department, the difficulties will be overcome, and a healthy herd will be built up. Other causes of death have been rinderpest, "kirichi" (a form of skin disease), liver disease, while some deaths have been due to diseases, the nature of which are difficult to determine.

The D.C.V.O., who was consulted on the subject of the herd generally and the prevalence of trypanosomiasis in particular, examined the herd, and agreed that the area should be treated as "fly" and made the following suggestions: that cattle should be injected with tartar emetic monthly throughout the rains; that shorter hours should be worked, better grazing facilities provided, and that the cattle should be regarded rather as a means of cheap cultivation, possible losses being ignored and the cost, if any, being charged to cultivation. It is to be hoped that this may be an extreme view, and that with the changes in management now being made, the herd will have better health and that the losses will be considerably lessened in the future. All fadamas (watercourses) where "fly" is likely to breed have been cleared out again and every possible step taken to stop direct infection.

Regarding the actual work on the farm, cattle have been increasingly used for the preparation and inter-crop cultivation of land in crops, while all the carting and carrying is done by them. They have lowered the annual cost of running the station considerably by reducing the number of labourers required: in the single operation of ridging up the land, for example, the cost is lower by fifty per cent. Some idea of the work done by the cattle may be gained from the fact that, in 1931, they broke 40 acres, ridged up 190, re-ridged 400 and cultivated 30. This work was in the cotton crop alone; they dealt with another 100 acres in connection with the cereal crop, making 760 acres in all. In 1932, notwithstanding the heavy loss in numbers, 1,300 acres have been worked by cattle cultivation.

Cattle camps have been erected in four different places on the boundaries of the farm, the sites being chosen so as to be convenient for working certain areas which lie at a considerable distance from the working centre of the farm. This arrangement simplifies the distribution of cattlemen, work, fodder, bedding and manure as well as ensuring that, in the event of an outbreak of contagious disease in

any one camp, the remaining cattle would be sufficiently isolated. At each camp a well has been sunk, a barbed wire fenced paddock erected and a few houses for cattlemen built, so that each place is self-contained, fodder and bedding being collected in the immediate locality.

A new cattle shed with covered midden has been erected, and an isolation camp built, at some distance from the other camps, in which new arrivals and sick cattle are placed. Trials in different forms of penning have been made, silo pits dug at each camp, and a cattle dip constructed. This ought to minimise the likelihood of tick-borne disease, and to a certain extent should have an effect on the direct infection by the tsetse fly. Though the dip has only been in use a month at the time of writing (November), a decided improvement is observable in the appearance of the cattle. All cattle have now been branded with their serial number in the herd book. There was an outbreak of rinderpest in April, but prompt measures were taken and all cattle given permanent immunisation by the double inoculation method. Large quantities of raw hide have been made in the past few months, and this is in use for all purposes connected with cattle cultivation.

In 1931, large herds of Fulani cattle grazed on the cotton fields after the crop had been harvested. They were night-kraaled on selected fields where it was thought most good would ensue. An area of 80 acres was given a dressing of F.Y.M. at the rate of 1 ton to the acre. The following year no Fulani cattle were allowed on the farm, as it was thought that they were possible disease carriers, rinderpest being prevalent in the neighbourhood. An area of 160 acres has been dressed in F.Y.M., again at the rate of 1 ton per acre. This rate appears to be quite sufficient and the results from such a small dressing are remarkable in all crops. Considerable local interest is shown in the cattle and their different uses, as is evidenced by the enquiries and visits of many native farmers.

WATERWORKS.

The principal item of note to be recorded during the period under review is the extension of the water pipe-line to four new Co-operative Farms. The scheme is now complete so far as this belt of farms is concerned. Another tank was built and from this the six houses beyond draw their supplies. The only other extensions were to the cattle dip and adjoining drinking trough, also to a point in Field 9, but this latter is not yet complete (See plan).

Several attempts have been made to sink wells, but until the past year these attempts were unsuccessful owing to a substratum of porous, chalky gravel. It was decided to pass through this, in order to see if

water lay beneath. For this purpose iron culverting was used as shuttering, and this ultimately lined the well. Water was found beneath the chalk in each case though not in very great quantities, but enough for supplying cattle camps at outlying places. Three such wells were completed.

BUILDINGS.

The new cattle shed and covered midden which were completed at the end of 1930, were unroofed by a violent tornado in the following year. The repair work has since been carried out.

Three automatic supply tanks were constructed, the first on the Co-operative farm site, the second in the Staff lines and the third (a much larger one), besides the new cattle dip.

No. 2 Staff House had the middle portion of the roof reconstructed and strengthened, also various repairs were carried out. The office was also re-roofed. No. 1 Staff House was also repaired and re-roofed.

In future a layer of cement will be laid on the top of all walls in the Staff Houses when they are re-roofed, in order to prevent white ants from getting into the roof.

A small shed has been constructed at the rear of the Ginnery and joined to it, which houses a small corn mill and a de-shelling machine for groundnuts. These machines are driven from the line-shaft in the Ginnery belt-race alongside.

A new half-size Standard store was put on the farm buildings site adjacent to the Ginnery. This store was later added to, all the materials being bought locally. The members were built in timber set in concrete, but the method of construction was copied exactly from the steel members. The cost per section of 12' of the new portion was £17, as against £27. 10. 0 per section, which was the cost ex-works of the steel and iron part. Even now, the storage accommodation is strained to the utmost in the cotton season.

In the construction of the cattle dip, advantage was taken of advice and information obtained from the Officers at Samaru and Shika Stock Farm. The result is remarkably creditable both as regards appearance and cost. The total cost was £80.

RESIDENTIAL SITE.

The fruit trees which have been planted from time to time are now bearing, with the exception of the grapefruit trees which were planted more recently.

The vegetable garden has now been moved so that it can be irrigated thoroughly without waste of water. The full advantages of the garden

and orchards are only now beginning to be reaped, as until recently all vegetables and fruit had to be purchased when opportunity offered, which was seldom.

CO-OPERATIVE FARMS.

Two years ago there were 12 farms fully occupied, and another 4 had been cleared, cultivated and cropped, but no houses had been built upon them. Four houses were built the following year, and also a house for the farm, C.I., which up to that time had not been tenanted, owing to its stony nature.

Since then 6 more farms were added in 1931 and 2 in the following year, making 24 farms altogether. The programme during the latter year was restricted, the Corporation having decided that clearing on the Main and Co-operative Farms should cease for the time being. The land on the first 6 farms is extraordinarily good, while the last 2 were rather stony. There were no lack of applicants for the new farms, notwithstanding the fact that a change in the tenancy conditions was made so that after the land had been cleared and a crop planted, the new tenant was required to keep it in order until all the farm was complete, after which it passed to his care completely. This was a measure of economy as previously the farm was not handed over until it was in full crop, the maintenance meanwhile being at the Corporation's expense.

The last two farms have, as yet, no houses constructed, but these will be built in due course.

All the farms are bearing excellent crops of cotton, and, with the exception of the two most recently made, all have had excellent crops of cereals during both of the past years. The changes among the farmers are few, only 4 of the farms having changed hands and in two of the cases the cause was death. The estimated acreage last year under cotton was 59 acres and during the present year, 75 acres, though probably this figure is on the low side.

It may be of interest to give some idea of the cotton produced by the Co-operative farmers. In 1931, the estimated area under cotton was 45 acres which produced 10,896 lbs. of seed cotton or an average of 242 lbs. per acre; last year there were 59 acres yielding 15,363 lbs. or 262 lbs. per acre. The highest individual yield per acre in the former year from any one farm was 450 lbs., and last year it was only 390 lbs. per acre, but this figure is still highly creditable for Northern Nigeria. In the latter year also, five farmers with approximately 20 acres of cotton between them, averaged no less than 345 lbs. per acre.

It is regretted that, so far, cattle cultivation has not made much headway with the farmers owing to the heavy mortality among their cattle. The reason for this is roughly the same as that given in connection with the cattle on the Main Farm, so that it is hoped that, with the experience gained on the latter recently, an all-round improvement may be looked for which will encourage the Co-operative farmers to go in more for cattle. While the Corporation's herd was passing through such a bad time, it was felt that the farmers could not conscientiously be asked to make any effort in this direction. Only one farmer owns any cattle at the moment. He has two cows and two bullocks. He brings his cattle twice a month to the cattle dip to be passed through with the Main Farm herd, and for this he pays a small charge. Two other farmers have hired teams and ploughs from the Corporation to do their farm work occasionally. These signs are definitely encouraging, as they show that the farmers realise the advantages of this form of cultivation, and once started, the scheme will undoubtedly spread. The chief obstacle is the question of disease, and once this is overcome, the rest ought to be easy. Unfortunately, the price obtainable for crops recently has not encouraged the farmer to spend what, to him, is a considerable amount of cash upon anything of a speculative nature.

METEOROLOGICAL NOTES.

The first rain fell on the 30th of March in 1931 and was preceded by unusually high temperatures. The highest temperature recorded since the farm began in 1925-26 was in April last year when 107 degrees was registered. The rains during the early part of the wet season were irregular and occasionally very heavy, neither of which are ideal for agricultural operations. Heavy rains fell in August and September which caused much erosion, but, unfortunately, they ended with September, which was too early to ensure a good cotton crop. The total rainfall for the year was 43.82 inches, which is slightly sub-normal. The harmattan began in October, sooner than usual. Cotton planting was held up by a dry spell in early July, which appears to be an annual occurrence.

The following year, the first threat of rain came as early as February, rain actually falling to the East and South. Small unrecordable showers fell in March, but in April there was a record fall for that month. The rainfall until the middle of July was a record for the station, but after that came the annual dry period, which was longer than usual, and again delayed cotton planting. Later the incidence was very good, and last rains fell on October 20th, the total of 45.38 inches being about

the average. With the exception of rather excessive erosion in the early rains, which damaged the fields and roads somewhat, the season has been one of the best yet experienced here, and the cotton crop shows exceptional promise.

LOCUSTS.

Large swarms of these pests have visited the neighbourhood from time to time each year, the damage not being very serious on the whole, but sufficient to cause lowered yields in the cereal crops. They appear to lay their eggs in the bush surrounding the farm and the hoppers, when hatched, make for the growing cereal crops. The Native Administration are very energetic in trying to beat out these bands of hoppers, and when the men engaged on this work are operating near the farm, the labourers are turned out to assist them.

GENERAL.

A party of students from the Katsina Training College, accompanied by the Provincial Superintendent of Education, visited the farm in December, 1931; the nature of the questions asked showed indications of a high standard of intelligence.

The District Officer, Birnin Kebbi, with whom were the Emir of Gwandu, the Alkalin Sokoto and party, have visited Daudawa. The Emir of Gwandu was exceptionally interested in the farm, and expressed a desire to take up cattle cultivation himself.

The C.V.O. accompanied by the Veterinary Adviser to the Colonial Office, Mr. Montgomery, visited Daudawa in January, 1932.

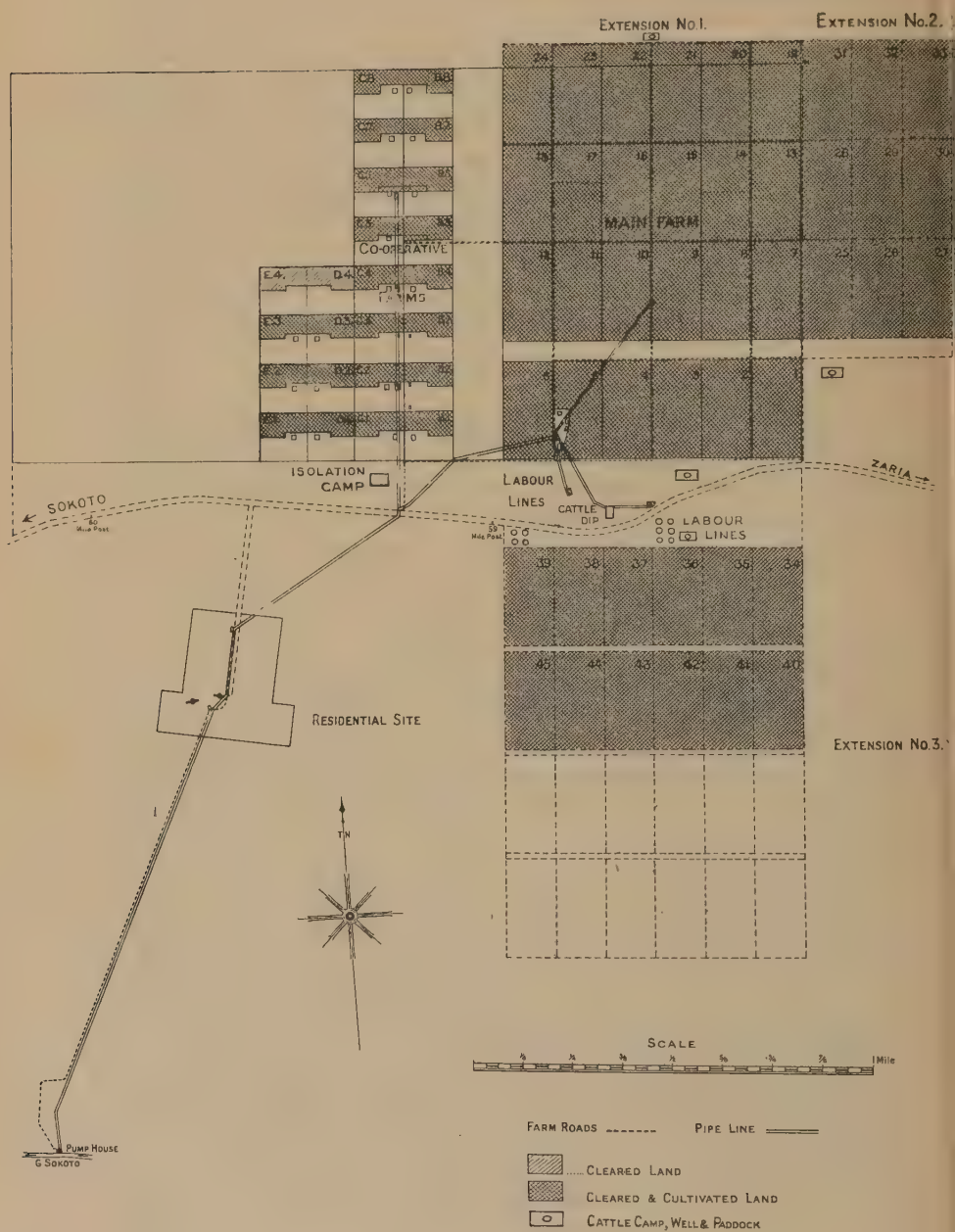
A new road has been built by the Katsina Native Administration to Shemi Station about 6 miles away. This, together with a level-crossing put in by the Nigerian Railways, enables the farm lorries to reach the freight sidings.

The Agricultural Departmental chemists visited the farm in March and took away soil samples from various fields.

The Manager proceeded on leave in April and returned to Daudawa in September, after which, the Assistant Manager, Mr. H. Hutchinson, left on transfer to South Africa. Mr. A. E. Casement, has taken up the duties as Assistant Manager at Daudawa.

In conclusion, the Manager welcomes this opportunity to thank the officers of the Agricultural and Veterinary Departments for their friendly co-operation and assistance in the work of the farm.

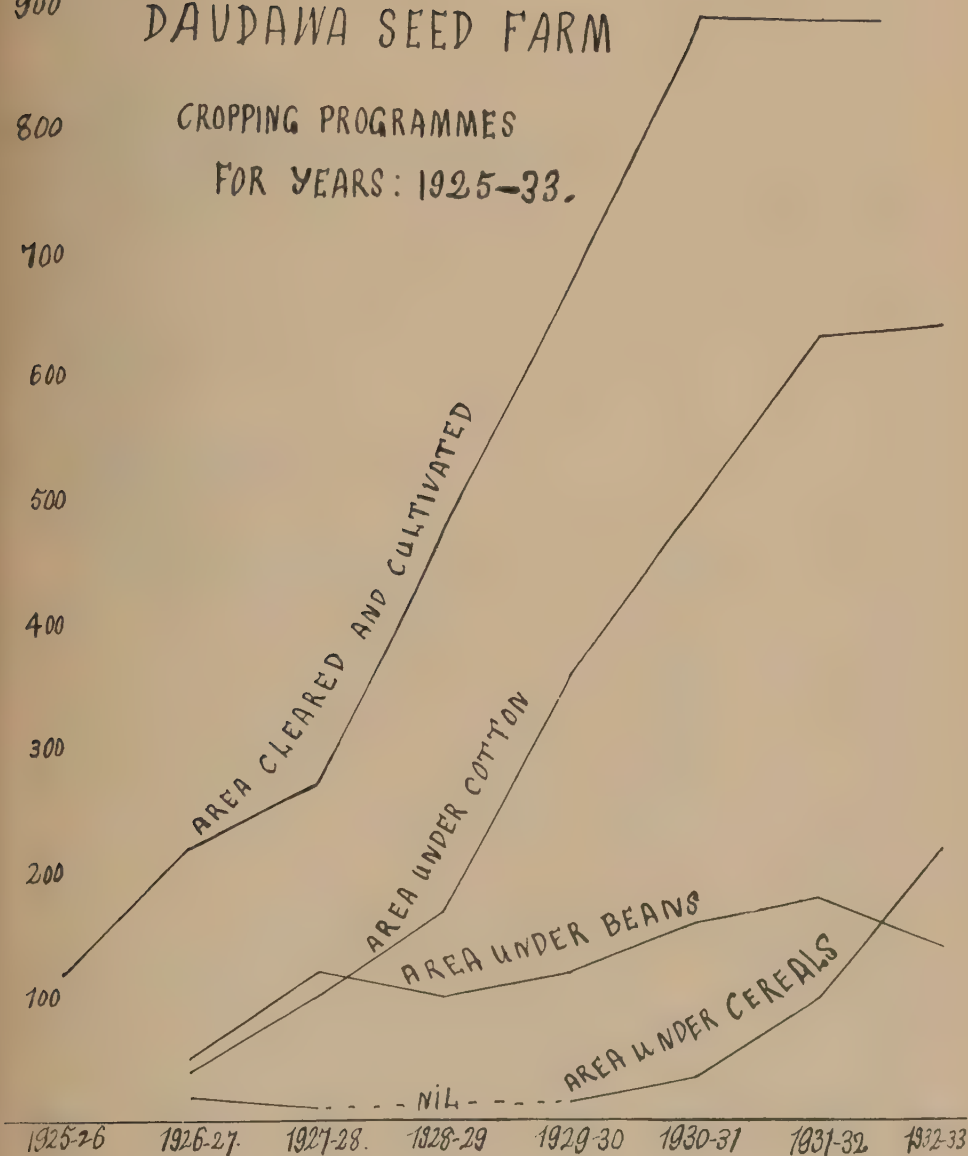
DAUDAWA SEED-FARM, NORTHERN NIGERIA, 1932.



ACRES.
900

DAUDAWA SEED FARM

CROPPING PROGRAMMES
FOR YEARS: 1925-33.



DAUDAWA SEED-FARM

1931-32

MONTHLY
MEAN TEMPERATURES
DEGREES - F

MAXIMUM

MINIMUM

TWO DAY TOTALS OF RAINFALL IN INCHES

NOVEMBER
1931

DECEMBER
1931

JANUARY
1932

FEBRUARY

MARCH

APRIL
3.96"

MAY
6.44"

JUNE
7.11"

JULY
4.23"

AUGUST
14.76"

SEPTEMBER

OCTOBER

TOTAL RAINFALL

100
90
80
70
—
3.0
2.5
2.0
1.5
1.0
0.5

[Included by courtesy of the Iraq Government.]

IRAQ

REPORT ON THE WORK ON COTTON OF THE CENTRAL EXPERIMENT STATION AT RUSTAM (NEAR BAGHDAD) FOR THE SEASON 1932

SUMMARY OF RESULTS.

BY
DARWISH al Haidari.

SEASON.

The general weather conditions of the winter preceding the cotton season were dry, precipitation being much below the average recorded for the last nine years (Graph). The scanty and badly distributed rainfall made it very difficult to prepare a good seed bed, and wind and dust-storms gave rise to further troubles during the sowing period. The continuous strong winds dried off the land so quickly that irrigations, both before and after sowing, were not of much use for germination; though the temperature and humidity during March and April were favourable. Matters were made worse by the shower of rain which fell during the early part of April, which formed a hard crust on the seed holes, so that the majority of the seedlings were unable to push through. A second post-sowing irrigation was given to help the seedlings, but without result. Much re-sowing had to be carried out during the latter part of April which ought to have been done during the early part of the month. In general, the weather conditions described inevitably made the crop late. During May and June conditions continued to be unfavourable for plant growth. Night temperatures remained unduly low; dust-storms occurred frequently and caused excessive shedding of squares, flowers and bolls, especially in those varieties of cotton in which hairiness is most pronounced. In August, September and October matters improved a little, plant growth was nearly normal, and a second flush of crop was hoped for. Some very cold spells occurred in November, however, which completely arrested plant growth and boll development.

SEED DISTRIBUTION.

Selected seed is distributed to growers through the British Cotton Growing Association. Unfortunately the quantity issued and the cotton production in Iraq (Table 1) are decreasing from year to year for many reasons, the most important of which, at present, is the prevailing low price. The total output for the 1928 season was 5,000 bales, while the estimate for the present season does not exceed 300 bales.

TABLE I.
SEED ISSUED AND COTTON PRODUCED IN IRAQ.

<i>Year.</i>	<i>Tons of seed issued by the British Cotton Growing Association.</i>	<i>Total production of 400-lb. bales.</i>	<i>Bales produced per ton of seed issued.</i>
1930	171	3,300	19
1931	71	965	13.5
1932	17.5	300*	17*

* Estimated.

The average yield of seed cotton per acre at Rustam was nearly the same as last year; 726 lbs. per acre being obtained over an area of 32 acres. Such a low yield is mostly attributed to the saline summer irrigation water obtained from the Diyala River.

BREEDING AND VARIETAL TRIALS.

The main object of the work of the Cotton Section continues to be the improvement of the ginning outturn of Mesowhite. Crosses of Mesowhite and R.138 (Acala) are under investigation. The ginning percentage of R.138, a selection from Acala, is much higher than that of Mesowhite, but the staple is shorter. Most of the single plant progenies consist of strains of Mesowhite, R.138 and R.124.

R.138 (Acala) proved itself a good yielding strain during the last two years and the best yielder during the present season, as is shown in Table 2. It is hoped to propagate this strain on a larger area next season.

TABLE II.
COTTON MAIN VARIETAL TEST (1932).

Rustam Number.	Mean yield of seed cotton per $\frac{1}{30}$ th acre plot, in lbs.	Standard Deviation.	Standard Error.	Difference between mean yield of R82 and the others.		Ginning, % age.	Lint Length in mm. (Halo).	Weight per 100 seeds, in grams.	Lint Index.
R.82 ...	24.5	13.11	5.4	—	—	28.1	30.1	11.64	4.55
R.124 ...	20.0	12.70	5.2	4.5	7.5	29.8	27.6	10.63	4.42
R.138 ...	42.4	14.96	6.1	17.9	8.2	30.9	27.0	15.47	6.73
R.150 ...	29.5	16.52	6.7	4.8	8.6	27.2	29.9	11.23	4.20
R.164 ...	17.5	10.94	4.5	7.0	7.0	28.1	29.2	11.12	4.34
R.165 ...	30.3	7.84	3.2	5.8	6.3	31.4	28.7	10.89	5.01

INSECT PESTS AND DISEASES.

Spotted Bollworm (Earias Insulana).—The attack of this insect was not severe, the cold spells of the past winter having materially reduced its numbers. In fact, the infestation was not felt economically until the beginning of September at which time hand collection of the infested squares and bolls was practised. It was intended to continue the sodium fluosilicate dusting experiment as a means of control, but the late appearance of the bollworm attack checked the work.

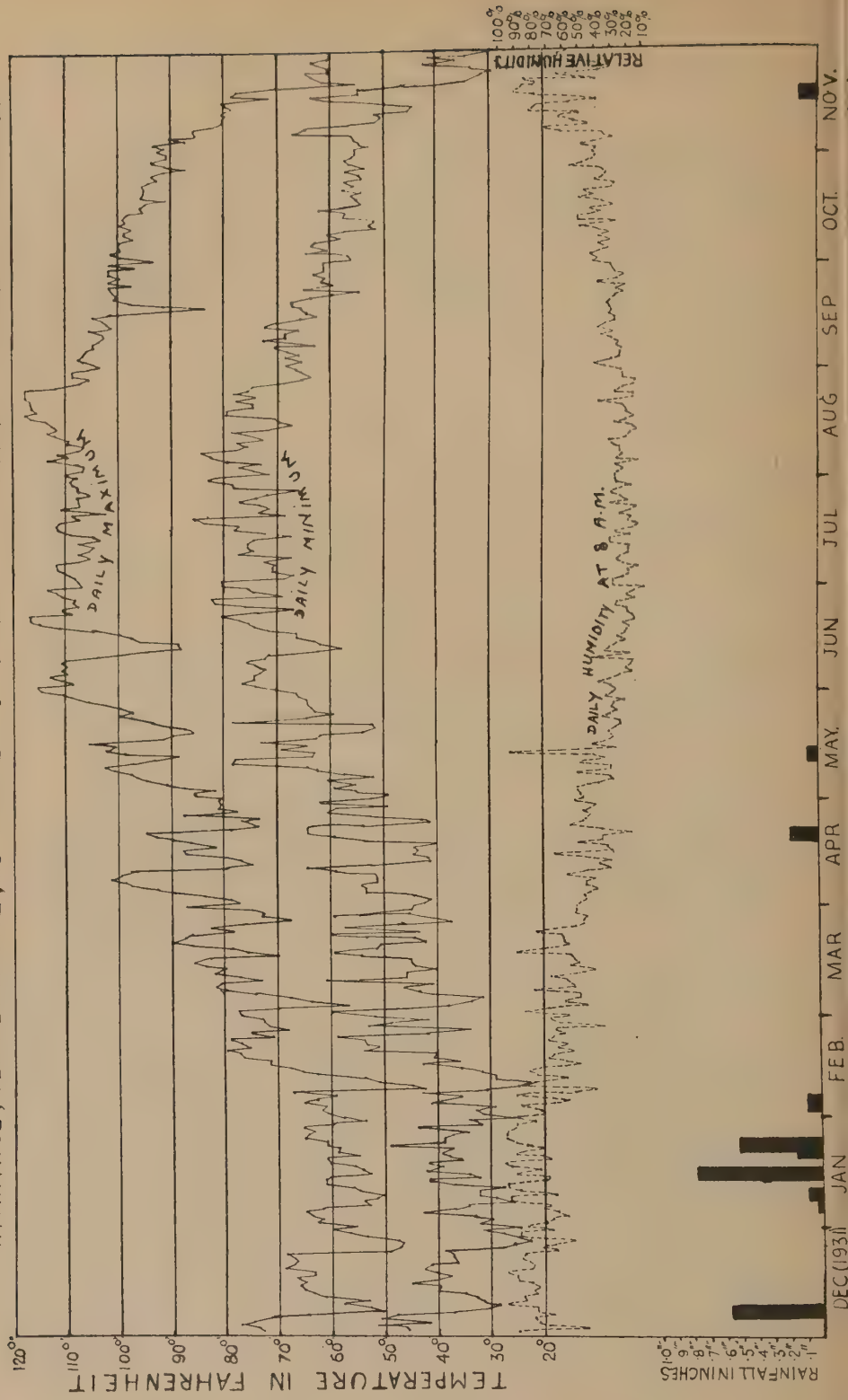
White Fly (Aleurodes).—This insect did serious damage, though its appearance was later than usual. No method of control was adopted, but it appears that high temperatures, coupled with extremely dry conditions, such as occurred in July and August, checked its spread.

Thrips.—The usual leaf curl caused by thrips appeared, but was of no economic importance. Most of the damage done to the seedling leaves was caused by the cold spells in April.

Rhizopus nigricans.—This fungus disease attack punctured or immaturesly opened bolls only. The method effective in bollworm control is also effective in controlling this disease.

A disease, having an appearance similar to Angular Leaf-Spot, was observed attacking cotton plants.

RAINFALL, TEMPERATURE AND HUMIDITY CHART - RUSTAM - DECEMBER 1931 - NOVEMBER 1932 -



WEST INDIES.

REPORT OF THE COTTON EXPERIMENT STATION, ST. VINCENT, FOR THE SEASON 1931-32.

SUMMARY OF RESULTS

BY

S. C. HARLAND AND S. H. EVELYN.

GENERAL.

After a close season of $3\frac{1}{2}$ months, planting at the Station began on September 1st and was completed on the 7th. The germination was excellent and very little supplying had to be done.

Weather conditions were less favourable than last year and this, combined with the indifferent attitude adopted by planters with regard to cultural operations on account of the depressed state of the cotton market, resulted in an average yield for the Island of only 114 lb. of lint per acre as against 153 in the 1930-31 season.

Damage from cotton Stainers and Pink bollworm was again negligible, and this is attributed to a combination of control methods and change of planting season.

In spite of heavy rains, loss from External Boll Disease (including Angular Leaf Spot and Blackarm) was not serious at the station; this is due to the fact that most of our strains are highly resistant to this disease.

EXPERIMENTAL.

(i) *The Breeding and Propagation of a Standard Strain of Superfine Sea Island Cotton.*—Sufficient seed of Standard Superfine Sea Island cotton was obtained from an isolated 9-acre multiplication plot this season to plant the whole of the Island's cotton area of 600 acres. This seed will be exclusively used in the 1932-33 season. It will, however, remain in cultivation for one year only, as an isolated area of 50 acres will be planted in September, 1932, with selfed seed of the best two Superfine strains at the Station. This will form the Island's crop in the 1933-34 season.

Only two superfine strains, V. 46-1-3 and V. 46-3-7, will be grown in pedigree culture next season. Their mean maximum lint lengths are 62.6 mm. and 61.6 mm. respectively. It is felt that the lint qualities of these cannot be further improved, so that in future attention will be devoted to strengthening the agricultural properties of Superfine. The above mentioned strains are considered to represent an improvement over the original standard Superfine pure line V. 135 bred out by Dr. Harland in 1918.

(ii) *The Production of Strains Resistant to Angular Leaf Spot.*—It is considered from results of observations on the incidence of Angular Leaf Spot in all of the pedigree cultures that all the strains at the Station now possess a considerable degree of resistance. Until a really bad Angular Leaf Spot year is encountered, results will not be further discussed.

(iii) *The Production of Strains Resistant to Shedding.*—The results of this season's work have proved that the tendency to shed buds and bolls is definitely hereditary. From a practical point of view it is believed that the highest yielding strains (expressed as mean number of bolls per plant) have been produced by selection of parent plants with initial low bud shedding. Thirty strains have been selected for observation in the coming season, when it is hoped to make exact comparisons of the influence of shedding on yield.

(iv) *Hybridization Experiments.*—(a) *Trinidad Red Kidney* $\times$ *Sea Island.*—As a result of genetic studies by one of us (S.C.H.) it has been found that the character Red Leaf, Weak Petal Spot, of the perennial Peruvian type Trinidad Red Kidney is allelomorphic to the character Green Plant Body, Strong Petal Spot. If red is transferred to a Sea Island plant body, it will be possible to distinguish any natural crosses in the commercial crop, since all plants with either a green plant body or strong petal spot are rogues. By repeated back-crossing the production of a Superfine Sea Island strain, pure for red plant body and weak petal spot, has been accomplished. Six selections have been made, with mean maximum lint lengths varying from 53.8 mm. to 58.2 mm., for further purification of staple length next season.

(b) *American Upland* $\times$ *Sea Island.*—As a result of an experiment to transfer Sea Island lint to an American Upland Plant Body (started by S.C.H. in 1929) five selections have now been made, varying in mean maximum lint lengths from 47.6 mm. to 51.8 mm. It is of interest to record that, with the exception of the lint, the plants are typically American Upland.

(c) *Ishan "A"* $\times$ *Superfine Sea Island.*—To improve the lint of the Ishan type a cross was made this season with Superfine Sea Island.

(v) *Production of Commercial Perennial Strains for Cultivation in the drier Grenadines.*—(a) *Moco Strains.*—From the original 4 strains brought from North Brazil in 1930, 18 sub-strains were grown this season in pedigree culture. As a result of two season's work a number of relatively pure strains have been isolated. Thirty-six selections were made this season with lint length varying from 45.2 mm. to 54.2 mm. A number of plants of each selection will be planted next season, so that a large amount of selfed seed of the best pure strains will be available for distribution in the drier Grenadines in 1933. A half-acre multiplication plot was sown in July in Union Island (one of the Grenadines) to selfed seed of a strain pure for 51 mm. length. Moco has proved itself vastly superior in quality and yield to the existing cottons in the drier Grenadines, and it is thought that if a cotton, like Moco, slightly superior to Egyptian Superfine, could be produced, it would be readily saleable. A cross between the best Moco strain and Superfine Sea Island was made this season.

(b) *Improved Marie Galante.*—As a result of purification and careful selection two sub-strains of Marie Galante, pure for lint lengths of 49 and 48 mm. respectively, have been isolated. For a perennial cotton, the lint of these is excellent, but the yielding capacity is much lower than that of Moco strain this season.

SPINNING TESTS.

Long Staple Upland.—The new long staple Upland alluded to in the body of this report was sent to the Shirley Institute for a spinning test. It was spun to counts of 80 and 100 and the following comments were made upon it.

“Sample (A) gave yarns of moderate strength and fairly good appearance. A cotton of this type would probably be combed in commercial spinning, but the small size of the sample submitted rendered this impossible. Although it approached Sea Island length it would not, however, compete with Sea Island cotton on account of its comparative coarseness, but might find a limited market where strength is not the first consideration.

“The hair weight per cm. is high for a cotton of such length and will probably prevent satisfactory spinning in Sea Island Counts. The hair characters of this cotton are similar to those of the Kidney × Sea Island hybrids from Fiji.”

Although the experiment to transfer Sea Island quality to an Upland plant body has not proved wholly successful, it is evident that length of staple can be transferred without difficulty, and without any marked impairment of the agricultural properties of Upland. It is intended to institute selection for a lower hair weight.

Trinidad Red Leaf. This is one of the local semi-wild varieties of tree cotton. Its behaviour in spinning was similar to that of medium

staple American. The strength proved to be slightly lower than that of Mississippi in 40's Yarn. The yarn appearance was good.

Sea Island Superfine.—Four samples of Sea Island Superfine were spun in the Experimental Department of the Fine Spinners' and Doublers' Association, and the hair characters measured at the Shirley Institute. It was thought that as inviable seeds are known to carry weak and often short lint, some improvement in spinning quality might result if the defective seeds were eliminated before ginning. This was done in three of the samples.

As will be seen from the annexed extract from the spinning test report some improvement was shewn, but not enough to make the elimination of defective seeds an economic proposition. The results of the spinning test on the combined superfine strains are highly encouraging and indicate that the old standard of purity has been attained in the course of two years of intensive selection. It may be noted that practically the whole Island crop of 1932-33 will consist of the purified Superfine type.

We beg to express our thanks to the Shirley Institute and to the Fine Spinners' and Doublers' Association for reporting on the hair properties and spinning quality of the cottons submitted to them.

The following is an extract from the Report received from The Fine Cotton Spinners' Association, Experimental Department :—

“The effect of eliminating the lint from defective seed is only barely perceptible in spinning quality, and in our opinion the cost of the operation is not justifiable. The spinning quality of the Experiment Station cottons is exceptionally good : these cottons are among the best we have spun here, and we have to go back to a V. 135 strain (1928 crop) to find a cotton of equal merit. Both samples are very much better than the Diamond Estate commercial cottons.”

FIJI

REPORT OF THE COTTON EXPERIMENT STATION,
SIGATOKA, FOR THE SEASON 1931-32.

BY

R. R. ANSON.

SUMMARY.

The general yield at the Experiment Station has been very disappointing, though better, in general, than has been obtained by outside farmers of this district.

The season has been remarkable for the continuance of dull and cloudy days, and although the rainfall has been in no way excessive, the overcast sky and humid atmosphere have provided ideal conditions for cotton diseases and insect pests such as blackarm, pink bollworm and jassid, greatly to the detriment of the ultimate yield of seed cotton. Jassid attack was particularly bad, it commenced late in February and continued well into May.

Although the yield from the New Guinea backcross appears to be very much lower than that which has been obtained from it in former years, the actual number of bolls set remains about the same and averages between three and four hundred per plant. It is unfortunate that this report has to be commenced before final pickings of the new hybrid have been completed, as it is apt to convey a wrong impression. At the time of writing, roughly 50% of the cotton from this variety has been harvested, and owing to late rains pickings are likely to continue until the end of November.

The following five crops viz. : cowpea, ground-nuts, maize, mung and Mauritius bean, were set out on the Latin square system and followed by cotton. Cowpea was taken as the standard. Significantly higher yields were obtained from cotton plots which followed maize and mung.

It has been decided to discontinue the growing of cotton commercially during the coming year, and to issue seed from the Cotton Station to a few isolated growers only. This decision has been made by the Government on account of losses experienced during the past two years. It is hoped to re-establish cotton-growing during 1933-4 season, when it is proposed to grow the new backcross in the semi-wet areas from Navua to Momi and from Tavua to Tailevu, while Sea Island will be grown in the dry belt from Yako to Tavua.

It is difficult to foresee what effect this year's recess will have upon the Indian ryot. Much will depend upon the point of view from which he sees it. It is most probable that he will clamour for that which he is unable to get, and that he will look after it better when he does get it again; on the other hand, it may be unwise to break him from the habit of growing cotton, if only for one year.

During the year 1933, the transinsular road should be completed. This should make it possible to open up fairly large areas which have formerly been inaccessible.

The Fijian Agricultural Scheme mentioned in my last report has now been fairly firmly established, and six centres have been opened. The area of arable land in each centre averages approximately one hundred acres. An agricultural Show for Fijians was held on the 21st September at the Cotton Station and it is proposed to make this an annual event. Each year it should be possible to open up one or two new centres until ultimately most of the cultivatable Fijian-owned land which has been lying idle in the past, will be brought into use.

The Fijian is likely to make a more successful cotton grower than the Indian because he is a fairly careful cultivator, and has neither rent to pay for his land, nor wages to pay for his employees.

GENERAL.

Staff.—Mr. W. L. Parham proceeded to Colo West on the 6th October, 1931, in order to supervise generally the Fijian Agricultural Scheme, and Mr. C. M. Dass took over the duties of farm Superintendent from that date.

Leave.—The writer proceeded on leave to New Zealand on the 8th July, returning again to Suva on the 2nd September.

EXPERIMENT STATION.

Cotton	...	...	...	...	...	12 $\frac{1}{4}$ acres.
Maize	...	...	...	...	...	11 "
Mauritius Bean	...	...	...	...	...	6 "
Ground-nuts	...	...	...	...	...	3 "
Mung	...	...	...	...	...	$\frac{3}{4}$ "
Cowpea (small)	...	...	...	...	...	4 "
Cowpea (Giant)	...	...	...	...	...	1 "
Citrus plantation	...	...	...	...	...	1 $\frac{1}{2}$ "
Trees	...	...	...	...	...	8 "
Sorghum	...	...	...	...	...	4 "
Tobacco	...	...	...	...	...	$\frac{1}{2}$ "
Potatoes	...	...	...	...	...	$\frac{1}{4}$ "
Rice	...	...	...	...	...	8 "
Pineapples	...	...	...	...	...	1 $\frac{1}{2}$ "
Miscellaneous	...	...	...	...	...	3 "
Rice bean	...	...	...	...	...	5 $\frac{1}{2}$ "
Bananas	...	...	...	...	...	2 "
Fallow	...	...	...	...	...	10 "
Total						82 "

Season and Climatic Conditions. The total rainfall recorded for the year from November to October inclusive was 64.71 inches, being 5.12 inches above that of the previous year and 1.53 inches above the average rainfall for the past five years. Rains set in fairly early and continued well into January with scarcely a break, so that it became difficult to keep weeds down, and most of the cotton was planted on an indifferent seed bed. Nut grass (*cyprus rotundus*) got such a hold, that seedlings were choked and some fields had to be ploughed out. Dull and sultry weather continued, and although the actual rainfall was not excessive, conditions were such that blackarm and casual boll rots played havoc with the crop. This was particularly noticeable on Sea Island and Shambur IV. The New Guinea backcross, being a later maturer and slightly more resistant, did not suffer quite so much.

Owing to hurricanes, floods and general set backs, the acreage under cotton in the surrounding district is about 1/5th of what it was last season, and the poor yields of this season will not give growers very much encouragement.

It will be noticed that during the past two years, work on minor crops has expanded considerably, the general idea being to convert the Cotton Station into a general experiment and seed station for the dry side of this island.

The supervision of the Fijian Agricultural Scheme was handed over to the Cotton Station staff during August, 1931, and although it added to the work somewhat, the two should combine very well together. The consolidated areas which are being cultivated by Fijians under our instruction will offer excellent opportunities for isolating increase plots of pure line seed, while the Cotton Station will be invaluable to the Fijian centres as a source from which acclimatized seed may be advanced.

New Guinea backcross and re-selections.—During the season 1930–31 five hundred progeny rows were planted from K3×S1 and K3×S5, two hundred and forty one from the former and two hundred and fifty nine from the latter. In the F₂ generation these were found to be splitting up for corolla spot as well as for other characters. In re-selecting, attention was only paid either to plants which carried a heavier corolla spot than either parent, or to those which had practically no spot, as it was thought that plants which carried the extra heavy spot might breed true not only in spot colour and intensity, but also in other characters, and likewise, it was thought that the ghost spot might breed true. These two types were therefore planted on isolated plots, care being taken to keep the deep-spotted plants together and the spotless ones together. In the F₃'s, 30% of the deep-spotted

plants were found to be breeding true, not only in colour of spot but in other characters as well, and 33% of those which carried practically no spot bred true to all characters. One hundred and forty four selections were made, and it is from these progeny rows that increase plots are being planted in the season, 1932-33.

Table I sets out some of the lint characters of the re-selections, and in re-selecting special attention has been paid to plant yield, colour and fineness of fibre, etc.

TABLE I.

<i>Plant.</i>	<i>Length of Staple</i>	<i>Lint Index.</i>	<i>Weight of 100 Seeds.</i>	<i>Colour of Lint.</i>	<i>Ginning per cent.</i>	<i>Remarks.</i>
K3 × S1/59/22/74	45 mm.	4.88	9.95	Cream	33%	28% conglomerated true in other characters.
K3 × S5/18/3/227	45 "	5.06	11.36	Brownish	31%	100% free seeded. Fairly fine and uniform.
K3 × S1/1/16/35	42 "	5.46	11.46	"	32.5%	Heavy yielder, but coarse in fibre.
K3 × S5/51/44/24	45 "	5.54	12.11	White	31.5%	Good, regular and fairly fine
K3 × S1/66/24/127	45 "	5.96	9.57	Whitish	39.5%	Jassid-resistant. Heavy yielder, coarse.
K3 × S1/1/25/63	46 "	5.03	12.0	"	30.8%	Sea Island habit of growth.
K3 × S1/88/44/172	42 "	5.70	11.07	Cream	32.5%	Heavy yielder
K3 × S1 × S/8/49/13	51 "	4.69	10.47	"	31.5%	Long and silky.
K3 × S1 × S.D. ...	50 "	4.57	9.72	"	30.5%	Dull but long.
K3 × S1 × S.L. ...	50 "	4.39	10.28	"	29.25%	"
K3 × S1 × S.I.D....	47 "	4.32	10.3	"	31.5%	Bright and good character.
K3 × S1 × S.I.L....	48 "	4.45	10.53	"	31%	" "

Most of these selections have yielded sufficient seed to enable us to plant up a five-acre increase plot in the 1932-33 season, which when supplemented by plants propagated vegetatively, should provide us with sufficient seed from any one selection for general distribution in this district in the season 1933-34. It is intended to try six of the best selections, one at each of the Fijian centres. In this way adequate isolation can be insured, and provided that the season is a normal

one, two bales from each selection will be forwarded to England for spinner's and broker's reports.

Closed flower type.—When making selections in the field of New Guinea backcross a plant was discovered possessing flowers which did not open, the plant was labelled and kept under observation. At the end of one month's observation it was found that none of the flowers had opened, but bolls had set quite satisfactorily. Seed was collected and planted, as it was thought the progeny might breed true to this peculiarity, and it would be useful to have a variety of cotton which is automatically self-fertilized. Fifty-six per cent. of the resultant plants inherited the closed flower habit, the remainder having either fully or partly opened flowers. The seed from these closed flowered types has been collected and a further trial will be made in the coming season.

Sea Island White Flower.—During season 1930-31 a plant with white flowers was noticed in a field of pure line Sea Island, and assuming that this might be a mutant similar in type to that described by Burd in the volume of Reports from Experiment Stations 1925-26, it was decided to have the plant selfed. The progeny has bred quite true to type in the season 1931-32. The lint from it is quite equal in strength, length and fineness, to the selected Sea Island, the staple measuring 51 mm.

VARIETAL TESTS.

The following varieties were set out in quarter-acre plots arranged on the Latin square system :—Trinidad Red Kidney, Sea Island, Green Kidney and Shambur IV. A very irregular stand was obtained caused by water-logged soil, and it was subsequently decided to plough the whole experiment under.

Shambur IV.—One acre of seed supplied from the Sudan was planted on land which had previously grown Mauritius bean. Four ploughings and three harrowings had to be given before a sufficiently good seed bed was obtained. Seed was planted on 24th December and excellent germination followed. During February, March and April, the crop was badly attacked by jassid. First squares appeared on the 8th February, but plants were not regular in habit of growth and on this account the time of squaring varied considerably. The first flowers were noticed on 4th March, and picking commenced on the 7th June. The plants were very irregular in habit and bolls did not open well. There appeared to be 496 plants possessing intermediate habit of growth, 234 possessing the Sakel habit and 136 Sea Island type. The crop was found to be very thickly infested with

pink bollworm, and on this account it was decided to have it uprooted and burnt before the last picking could be completed. The plot yielded 94 lbs of seed cotton. The lint was in most cases very fine and strong, but it varied greatly in colour and length, some plants producing a lint very similar to that of Brown Egyptian.

XH 1029.—The seed was obtained from the Sudan through the Corporation. On 26th December two lines were planted and alternated with a control of New Guinea Hybrid; germination was good, but plants did not show much resistance to jassid, and were not very regular in habit, though bolls opened much more freely than those of Shambur IV. The yield, however, was poor giving only 121 lbs per acre, as compared with the control lines of New Guinea backcross which have already yielded 434 lbs per acre, with still a fair amount of cotton to come.

TRK $\times$ *S*.—Trinidad Red Kidney $\times$ Sea Island. Seed obtained from the Cotton Research Station, Trinidad, was planted at the same time as *XH 1029*; it showed practically no resistance to jassid and has so far yielded 188 lbs of seed cotton per acre and there is a little more to be picked.

All green plants from this cross were segregated and backcrossed with Sea Island. These are now in the F_3 stage and appear to be breeding true. The lint is strong and bright averaging 40 mm. in length and ginning out at 35.3%.

Sea Island.—Seed from selected plants was planted out on a fair seed bed on the 25th November. Plants germinated well and a very uniform stand was obtained. During February and March the plants were badly attacked by jassid, and ultimately yielded only 200 lbs. of seed cotton per acre.

TOPPING EXPERIMENT.

Two acres of New Guinea backcross, one of $K3 \times S1$ and one of $K3 \times S4$, were pruned to within 3' 6" of the ground in order to ascertain whether this practice would have a stimulating effect and possibly produce an earlier crop. All cotton was pruned and branches were cleared away between the dates of January 22nd and February 1st. Toppings were burnt, and each row received one ploughing and four scarifyings during the season. Picking commenced on the 10th June and was completed by the middle of September. It was found that topping had the effect of inducing earlier maturity, but shedding was bad, and final yields were approximately one third of those obtained from the annual plants used as controls, the yields per acre being

232 and 210 lbs. of seed cotton respectively. The cotton appeared harsh and irregular but this may have been purely due to seasonal effect.

MANURIAL TESTS.

The fertilizer trials carried out at the Station during season 1930-31 were repeated in 1931-32, but on account of very severe jassid attack; no significant results were obtained, and plot yields were very low. It was therefore decided not to include the results in this report.

ROTATION CROP TRIALS.

In season 1930-31, a series of five crops including Cowpea, Pea-nuts, Mung, Maize and Mauritius bean, were set out on randomized plots measuring $\frac{1}{8}$ th of an acre on the Latin square principle. These crops were each followed by cotton, and Table II gives the resultant yields; the cowpea was taken as the standard.

TABLE II.

<i>Average yield</i>	<i>Cowpea</i>	<i>Pea-nuts.</i>	<i>Maize.</i>	<i>Mung.</i>	<i>Mauritius bean.</i>	<i>Mean.</i>	<i>Standard error.</i>
Seed cotton. lbs per acre ...	304	304	347.5	349.6	313.6	323.74	28.8

Significantly higher yields were obtained from cotton which followed mung and maize. This experiment is to be repeated in the coming season, care being taken to ensure that the same rotation is adhered to.

INSECT ATTACK AND DISEASES.

The loss due to insect attack during the past season was very considerable. On the Station and elsewhere a large amount of shedding of flowers and young bolls was due to jassid attack, which commenced in February, and did not abate until May, when dry weather and cool nights seemed to settle it. A certain number of plants were found to be practically resistant, and the difference between the yield of these and of the non-resistant types is very marked.

Pink Bollworm. (*Platyedra gossypiella*).—This pest was very active, particularly on Shambur IV from the Sudan. The prospective recess from growing cotton for the period of one year which this Colony is anticipating, may act as a control and enable the Chalcid pupal parasite to keep the pest more in check.

Tip Worm (*Earias fabia*).—Tip worm was found to be the cause of a large percentage of square and bud shedding during March and

April. This was probably seasonal, as their natural parasites, hornets etc., may possibly be less active during wet and dull humid days than on sunny ones.

Harlequin bug (Tectacoris lineola).—The Harlequin bug was again kept in check at the Station by hand collection and has not therefore become a serious pest.

Cotton Stainers (Dysdercus insularis).—This pest has been fairly active, but will also probably be kept in check by a close season of twelve months.

Blackarm (Bacterium malvacearum).—The disease made its appearance during March and in some fields caused a good deal of boll rot. Shambur IV and Sea Island varieties suffered most from its attack; the New Guinea hybrid appears to be partially resistant.

FUTURE PROSPECTS.

The past two or three seasons have been anything but encouraging for the Indian and Fijian growers; nevertheless, there is likely to be a loud outcry from the Indians, now that the Government has announced that cotton-growing is to be suspended for twelve months. Store keepers in outlying places are complaining that growers have now no money crop with which to pay their debts, and land owners are making the same complaint about their tenants. All this may bring cotton-growing into the limelight again, and thus enable us next season to get in a fairly large area, without which, it is impossible to keep overhead costs down. It is hardly likely at present that a cotton valued at less than 1/- per lb would be a paying proposition in this country where the cost of transport is so high, but prices of cotton and communication by road are both showing signs of immediate improvement. It is probable therefore that cotton will become quite a profitable little industry, especially for the native of this country. It is to the Fijian that one should look as the coming cotton producer: the Indian is, perhaps, more ambitious in his agricultural pursuits, but less responsive to agricultural instruction.

SIGATOKA EXPERIMENT STATION, FIJI. RAINFALL ~ SEASON 1931-32 (IN 2 DAY TOTALS.)

MONTH	RAINFALL (IN 2 DAY TOTALS.)
NOVEMBER	6.1"
DECEMBER	7.55"
JANUARY	15.21"
FEBRUARY	13.16"
MARCH	5.94"
APRIL	5.57"
MAY	2.71"
JUNE	1.35"
JULY	5.29"
AUGUST	1.46"
SEPTEMBER	.30"

5.0"
4.5"
4.0"
3.5"
3.0"
2.5"
2.0"
1.5"
1.0"
.5"

(6.95")

List of Publications—Continued.

- *"Memoirs of the Cotton Research Station, Trinidad." Series B. Physiology.
No. 1. Studies on the Transport of Carbohydrates in the Cotton Plant.
T. G. Mason and E. J. Maskell. 1928. Price **2s. 6d.**, post free.
- *"Reports received from Experiment Stations, 1927-28." Price **2s. 6d.**, post free.
- "Memoirs of the Cotton Research Station, Trinidad." Series A. Genetics,
No. 1. The Inheritance of (i) Petal Spot, (ii) Pollen Colour, (iii) Corolla
Colour. S. C. Harland. 1929. Price **2s. 6d.** post free.
- "Reports received from Experiment Stations, 1928-29." Price **2s. 6d.**, post free.
- "Memoirs of the Cotton Research Station, Trinidad." Series B. Physiology.
No. 2. Studies on the Transport of Nitrogenous Substances in the Cotton
Plant. Parts I., II. and III. E. J. Maskell and T. G. Mason. 1930.
Price **2s. 6d.**, post free.
- "Memoirs of the Cotton Research Station, Trinidad." Series B. Physiology.
No. 3. Studies on the Transport of Nitrogenous Substances in the Cotton
Plant. Parts IV. and V. E. J. Maskell and T. G. Mason. 1930.
Price **2s. 6d.**, post free.
- "Conference of Workers on Cotton Growing Problems, held August, 1930."
Papers and Discussions. Price **2s. 6d.**, post free.
- *"Reports received from Experiment Stations, 1929-30." Price **2s. 6d.**,
post free.
- "Memoirs of the Cotton Research Station, Trinidad." Series A. Genetics.
No. 2. Studies on the Inheritance of Corolla Colour and Petal Size in
Asiatic Cottons. J. B. Hutchinson. 1931. Price **2s. 6d.**, post free.
- "Reports received from Experiment Stations, 1930-31." Price **2s. 6d.**,
post free.
- "Memoirs of the Cotton Research Station, Trinidad." Series A. Genetics.
No. 3. (a) Reversal of Dominance in the Interspecific Cross *G. barbadense* Linn. $\times$ *G. hirsutum* Linn. and its Bearing on Fisher's Theory
of Dominance. (b) The Inheritance of Chlorophyll Deficiency in New
World Cottons. S. C. Harland. (c) "Crumpled." A New Dominant
in Asiatic Cottons produced by Complementary Factors. J. B.
Hutchinson. 1932. Price **2s. 6d.**, post free.
- "Memoirs of the Cotton Research Station, Trinidad." Series A. Genetics.
No. 4. The Inheritance of Anthocyanin Pigmentation in Asiatic
Cottons. J. B. Hutchinson. 1932. Price **2s. 6d.**, post free.
- "Reports received from Experiment Stations, 1931-32." Price **2s. 6d.**,
post free.
- "Memoirs of the Cotton Research Station, Trinidad." Series A. Genetics.
No. 5. Cytological Studies in Cotton. I. The Mitosis and Meiosis in
Diploid and Triploid Asiatic Cotton. A. Skovsted. 1933. Price **2s. 6d.**,
post free. (*Ready May.*)

* Out of Print.

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